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School of Forestry
and
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Studies

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Studies

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Typesetting by Electronic Composition, Inc., Washington, D.C.
Printed by Greensboro Printing Company, Greensboro, N.C.

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University Administration

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Administration of the School of Forestry and Environmental Studies

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Robert L. Barnes, M.F., Ph.D., *Director of Admissions*

Kenneth R. Knoerr, M.F., Ph.D., *Director of Graduate Studies in the Department of Forestry and Environmental Studies of the Graduate School*

Judson D. Edeburn, M.F., *Duke Forest Resource Manager*

Stephen A. Anderson, M.S., *Program Coordinator of Integrated Case Studies in Natural Resource Analysis*

Faculty

Roger F. Anderson, Ph.D., *Professor*, B.S., Forestry, M.S., Entomology, Ph.D., Entomology, University of Minnesota.

Current research interests: stand and site characteristics of southern pine beetle "kills"; the resistant or repellent characteristics of trees that affect tree selection by bark beetles and ways to incorporate these protective characteristics in future pine stands; role of genetic plasticity in heterozygous populations with respect to insect abundance, especially for those populations that commonly exhibit cyclic fluctuations; the behavioral ecology of subcortical feeding insects.

Robert L. Barnes, Ph.D., *Professor*, B.S., Botany, M.F., Forest Soils, Ph.D., Plant Biochemistry, Duke University

Current research interests: tree physiology, specifically the effects of air pollutants on forest vegetation, nitrogen metabolism and transport, modeling of biochemical and growth processes, oleoresin formation and means to stimulate it.

Frank J. Convery, Ph.D., *Associate Professor*, B. Agr. Sci., Forestry, M. Agr. Sci., Forestry, University College, Dublin, (Ireland), M.S., Forestry Economics, Ph.D., Forestry Economics, State University of New York, College of Environmental Science and Forestry.

Current research interests: application of benefit/cost analysis in public forest land decision making. Exploring the economic and environmental implications of expanding United States wood supply. Deriving a credible evaluation method for recreation values. Use of a systems approach in studying the interdependencies among resource-environmental systems and tracing their implications for policy.

George F. Dutrow, Ph.D., *Adjunct Associate Professor*, B.S., General Science, M.F., Wood Technology, Ph.D., Forest Economics, Duke University.

Current research interests: measuring the physical and financial implications to the landowner, region, and nation of silvicultural treatments to increase timber supplies and other products of forest lands. Quantifying and developing the implications of applying or omitting research recommendations for forest management. Estimating net economic results of the evolving technologies of genetically improved or disease resistant planting stock, forest fertilization, and site selection and modification. Evaluating alternative land use programs, management treatments, and policies in terms of economic and physical outputs and trade-offs of services and products from forest lands. Examining methodologies for ascertaining future prices, rates of discount, investment criteria, and distributional effects of various management policies.

Daniel H. Gelbert, M.F., *Adjunct Assistant Professor*, B.S., pre-Forestry, M.F., Forest Management, Duke University.

Current research interests: development of management plans for private, nonindustrial owner-ships, development of case history and case study approaches to management instruction and research

William J. Hart, M.P.A., *Adjunct Professor*, B.S., Forestry, Utah State University; M.P.A., Resource Economics and Administration, Harvard University.

Current research interests: resource planning and development; coastal zone and other regional approaches to resource management; intergovernmental relations.

Milton S. Heath, Jr., LL.B., *Adjunct Professor*, A.B., Harvard; LL.B., J.D., Columbia University.

Current research interests: environmental and natural resource law and administration; legislative and other governmental aspects of resource development

Henry Hellmers, Ph.D., *Professor*, B.S., Forestry, M.S., Forestry, Pennsylvania State University; Ph.D., Plant Physiology, University of California, Berkeley.

Current research interest: physiology of forest trees, primarily in the area of environmental factor effects.

Benjamin A. Jayne, Ph.D., *Professor*, B.S.F., Forestry, University of Idaho; M.F., Forestry, Ph.D., Forestry, Yale University.

Current research interests: management of natural resource systems. In particular, the application of mathematical models, including simulation and optimization techniques, to decision making in the management of renewable resources. The application of physical theory to the transport of mass and energy in terrestrial and aquatic ecosystems including concepts from thermodynamics and fluid mechanics. Development of basic theory for predicting the physical properties of particulate materials such as soils and other composite media.

Frederick C. Joerg, M.B.A., *Professor*, B.S., Fordham University; M.B.A., Harvard University.

Current research interests: financial problems of the firm, including cash management, receivable management, short-term financial planning, cost of capital, capital budgeting, dividend policy, long-term financial planning. Problems of corporate strategy and policy formulation.

Kenneth R. Knoerr, Ph.D., *Professor*, B.S.F., Forestry, University of Idaho; M.F., Forestry, Ph.D., Yale University.

Current research interests: development of predictive models for the energy and mass exchange processes and the state of the atmosphere that characterizes the biological environment (the microclimate). These physical models can be interfaced with other biological models to give a better understanding of how biological systems interact with, respond to, and are controlled by their environment. The models can also be used to solve more applied problems such as those concerned with the primary production of forest stands, effects of land management practices on water yield, or the impact of environmental perturbations on the ecosystem. In parallel with the modeling there has been an intensive experimental effort to collect physical environment and biological data to both test and improve the models. Future work will include the development of models for special purposes, such as prediction of characteristics of the microclimate from infrared mapping of the surface radiometric temperature.

Louis J. Metz, Ph.D., *Adjunct Associate Professor*, B.S., Forestry, Michigan State College; M.F., Forest Soils, Ph.D., Forest Soils, Duke University.

Current research interests: study of the formation, composition, and decomposition of the forest floor, and the role of soil animals in the decomposition process. Investigations of the influence of forest cultural practices, such as fertilization and fire, on the populations of soil animals. Studies of the influence of the forest floor on the biological, chemical, and physical nature of the underlying mineral soil.

Jane Philpott, Ph.D., *Professor*; A.B., Education and Biology, Harris Teachers College, M.S., Botany, Ph.D., Botany, University of Iowa.

Current research interests: anatomy of woody plants, with emphasis on anatomy of leaves growing in different environments.

R. Rajagopal, Ph.D., *Assistant Professor*; B.S., Mathematics and Physics, University of Bombay; M.E., Operations Research, University of Florida; Ph.D., Resource Systems Management, University of Michigan.

Current research interests: study of the environment with various sensors and receptors, and the analysis of environmental data using mathematical models with and without clearly defined objectives. Applications of general systems theory or studies in understanding the system as a whole. Study of large-scale systems through multidisciplinary research. Development of effective bioenvironmental management information systems. Bioenvironmental systems analysis.

Charles W. Ralston, Ph.D., *Professor*; B.S.F., Forestry, Colorado State University; M.F., Forest Soils, Ph.D., Forest Soils, Duke University.

Current research interests: forest soil-site classification through the study of physiographic and edaphic characteristics related to forest site productivity. Derivation of multiple regression soil-site prediction equations. Development of equations for estimating biomass and nutrient contents of forest stands from diameter and height measurements. Study of improvement of forest sites via drainage, disturbance of forest soils by logging, effects of fire on soil physical and chemical properties, and effects of intensive forest management practices on quantity and quality of streamflow. Diameter growth of loblolly pine as related to soil water supplies; nutrition of slash pine seedlings as related to light, temperature, and aeration; oxidation-reduction reactions of soils.

Curtis J. Richardson, Ph.D., *Associate Professor*; B.S., Ecology, State University of New York at Cortland; Ph.D., Ecology, University of Tennessee.

Current research interests: ecosystem analysis of wetland and forest systems. Specific research on the linkages between terrestrial and aquatic ecosystems and the effects of large-scale perturbations on such systems. Studies at the process level include productivity, biogeochemical cycling, and successional patterns in wetlands and forest systems. Applied ecology research includes studies on urban-forestry problems, wastewater applications on ecosystems, and acid rainfall.

Jack P. Royer, Ph.D., *Assistant Professor and Research Associate*, B.S., Forestry, Pennsylvania State University; M.S., Public Affairs, American University; Ph.D., Natural Resources, Cornell University.

Current research interests: natural resource policy and administration of forests, land and water resources, and outdoor recreation. Environmental law. Application of resource economics, resource planning, and various analytical methods to formulation of resource policy.

Gerald R. Stairs, Ph.D., *Professor and Director of the Center for Resource and Environmental Policy Research*; B.S., Forestry, Washington State University; M.F., Ph.D., Forestry, Yale University.

Current research interests: application of organizational and administrative opportunities for university participation in public and private decision making. Renewable natural resource systems management including improved biological productivity. Relationship of a free enterprise system to regulation and policy aspects of resource management in terms of rural development, economic and environmental impact. Interaction of national economic development of natural resources and related international supply sources, trade regulation, and policy or legal factors.

William J. Stambaugh, Ph.D., *Professor*; B.S., Forestry, M.S., Forestry, Pennsylvania State University; Ph.D., Forest Pathology, Yale University.

Current research interests: pathology of woody plants. Ecology of soil microorganisms with emphasis on mycorrhizae and root diseases of trees. Disease control strategies including biocontrol systems.

William A. Thompson, Ph.D., *Assistant Professor*, B.A., Mathematics, Pomona College; Ph.D., Ecology, University of British Columbia.

Current research interests: population biology of the western tent caterpillar, emphasizing dispersal, fecundity and insect-plant interactions. Comparative studies of the ecology of the genus *Malacosoma* (tent caterpillars). Modeling predation and competition processes with dispersal and spatial components. Modeling resource systems for policy assessment.

J. Michael Vasievich, Ph.D., *Adjunct Assistant Professor*; B.A., Biology, Franklin and Marshall College; M.F., Forestry, Ph.D., Forest Economics, Duke University.

Current research interests: analysis of the economic implications of alternative fire management strategies, particularly the use of prescribed burning in the South. Integration of fire behavior prediction technology with economic criteria of cost and impact for evaluation of fire management

activities as a production process. Investment analysis of alternative forest land management regimes, especially intensive timber production and assessment of trade-offs between timber and other forest products.

P. Aarne Vesilind, Ph.D., *Associate Professor*; B.S., M.S., Civil Engineering, Lehigh University; M.S., Sanitary Engineering, Ph.D., Engineering, University of North Carolina at Chapel Hill.

Current research interests: wastewater and sludge management and disposal. Solid waste and resource recovery problems.

Fred M. White, M.F., *Assistant Professor*, B.S., University of the South; M.F., Forestry, Duke University.

Current research interests: the blending of new concepts, tools, markets, and practices with the traditional silvicultural techniques of natural regeneration. Goal is to develop methods whereby a small landowner may obtain adequate, not maximum, regeneration of a species appropriate to the site or to individual desires. Methods for reducing site preparation costs for natural regeneration. Economic comparisons between intensive and extensive practices.

David O. Yandle, Ph.D., *Associate Professor*; B.S., Wood Technology, M.S., Wood Technology, Ph.D., Statistics, North Carolina State University.

Current research interests: theory and development of sampling techniques for forest resource problems involving multistage sampling, sampling in the absence of a "well-defined frame," and simplifying sampling techniques for increased field efficiency with relatively small loss in per unit sampling efficiency.

Staff

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Jo W. Russell, *Secretary*

Barbara T. Williams, *Secretary*

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Fred L. Mowry, *Research Associate*

Faculty Emeriti

Leon Edward Chaiken, M.F., *Professor Emeritus*

Paul Jackson Kramer, Ph.D., *James B. Duke Professor Emeritus*

James Granville Osborne, B.S., *Professor Emeritus*

Albert Edward Wackerman, M.F., *Professor Emeritus*



School of Forestry and Environmental Studies

Calendar*

1979

July		
16	Summer session begins	
August		
17	Summer session ends	
27-29	Registration for fall semester	
September		
4	Fall semester classes begin	
5	Drop/add begins	
14	Drop/add ends	
October		
29-31	Registration for spring semester, 1980	
November		
1	Registration for spring semester, 1980	
20	Tuesday, Thanksgiving recess begins at 6 P.M.	
26	Classes resume	
December		
6	Fall semester classes end	
7-13	Graduate reading period	
14	Final examinations begin	
20	Final examinations end	

1980

January		
11	Registration of all new and nonregistered returning students	
14	Spring semester classes begin	
15	Drop/add begins	
25	Drop/add ends	
March		
7	Spring recess begins	
17	Classes resume	
24-26	Registration for fall semester, 1980 and summer, 1980	
April		
21	Spring semester classes end	
22-28	Graduate reading period	
29	Final examinations begin	
May		
5	Final examinations end	
10	Commencement begins	
11	Graduation exercises	

*The dates in this calendar are subject to change

To the Prospective Student

The School of Forestry and Environmental Studies, a professional-graduate school functioning within a great university, focuses its efforts on the science, management, and policy of natural resources and the environment. Its Master of Forestry degree is designed to prepare professional forest managers of the future in both the public and private sectors. Its Master of Environmental Management degree is intended for those who wish to prepare themselves in some aspect of the broader field of natural resources. The school offers concurrent degrees with the Graduate School of Business Administration and the Institute of Policy Sciences and Public Affairs. Its doctoral program is designed for those interested in teaching or in research in a university, branch of government, or private industry.

For each of these programs we seek able students who are motivated to research and analyze complex natural resource and environmental problems. We accept undergraduates from many educational backgrounds with but a modest set of prerequisites. However, we expect that each degree candidate will become highly disciplined in some aspect of the analysis of resource problems during the period of study at Duke.

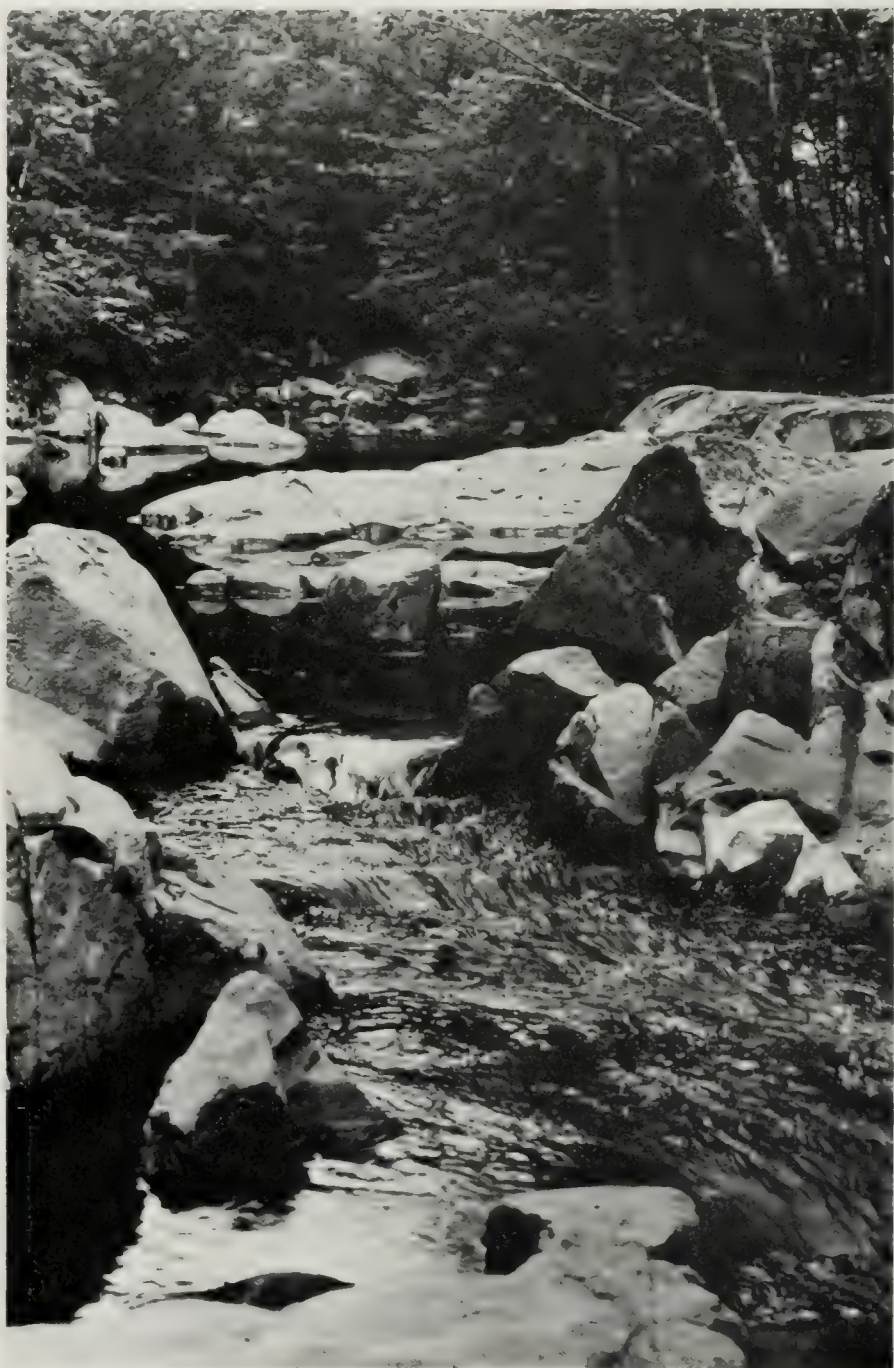
New programs under development in the school, particularly the intensive courses, are designed to meet the needs of mid-career professionals about to enter the ranks of senior management. Supporting all of these educational programs are the research interests of an outstanding faculty committed to the advancement of knowledge of resources and the environment.

This bulletin provides information about our degrees, programs, and research. In addition to these more traditional approaches to education, the bulletin also describes numerous other educational opportunities including field studies, seminars, symposia, and case study development.



Benjamin A. Jayne
*Dean of the School of Forestry and
Environmental Studies*

General Information



Objectives

The School of Forestry and Environmental Studies pursues a broadly based program of research and education at the graduate level. Its programs are designed to educate professionals, scientists, and academicians to analyze a wide range of environmental and natural resource problems.

After nearly fifty years of forestry research and education at Duke, the school has shifted from a focus on woodland productivity and protection to a focus on ecosystem productivity and protection. The land and its associated components, including plant and animal communities, water, and air, are integral parts of the orientation of the school. The emphasis is on defining objectives for forest and natural resource management, understanding the interrelated constraints—physical, biological, ecological, economic, legal, and social—and devising and testing alternative management solutions. Indeed, problem analysis is the central focus of all programs of the school. The student will learn the capabilities and limitations of quantitative analysis and seek imaginative solutions for problems requiring a qualitative approach.

The school is particularly interested in the development of a holistic view of the environment and natural resources. This viewpoint requires the application of knowledge from the natural, social, and management sciences. Students are encouraged to integrate studies in natural resource science, management, and policy formulation. The approach is first to identify problems, then to synthesize information, to develop critical analyses, and finally to plan and design solutions.

This approach is pursued by research, formal courses, seminars, field studies, and special conferences and symposia. Informal contact among students, faculty, alumni, and practicing professionals forms a strong part of the program. A number of academic and professional disciplines are represented on the faculty, and practicing professionals are frequently involved in teaching as well as in research. Several government career employees are usually in residence as adjunct faculty members.

The school periodically sponsors conferences and symposia on subjects of major interest and concern to persons involved in resource management. These offer current viewpoints of outstanding individuals concerned with various aspects of natural resources and the environment.

Programs are designed for students drawn from a wide variety of undergraduate backgrounds in the natural and social sciences and from programs in forestry, engineering, business, and environmental studies. The goal is to help all students

acquire the basic technical skills, knowledge, insight, and methods of analysis for solving natural resource and environmental problems.

Because integrated management of natural resources is in the early stages of development in this country and abroad, the school is changing rapidly and extensively. These changes offer many opportunities to explore new areas of research and education, to sharpen the capacity to analyze environmental and resource problems, and to contribute to the development of new professions.

An essential ingredient in this period of changing orientation in the school is a high level of student participation. A special student committee advises the dean and faculty on curriculum content and structure, research programs, degree requirements, and other matters pertinent to the goals of the school. Students serve on most school committees, and they attend faculty meetings on a regular basis. Students also participate regularly in the planning of major conferences and symposia. Within the limit of school resources, students are encouraged to travel to local and regional meetings of professional and scientific societies. These activities are considered to be an essential part of the educational process.

History

Duke University developed from Union Institute, a small school established in 1838 in Randolph County, North Carolina. The name was changed to Normal College in 1851, and in 1859, to Trinity College. The college was moved to Durham in 1892. With the establishment of the James B. Duke Indenture of Trust in 1924, Trinity College became Duke University. At the outset, the University developed around a core of undergraduate programs. Later the Graduate School and professional schools of Medicine, Nursing, Law, Engineering, Divinity, and Business Administration were added. In 1932, forestry instruction was offered for students of Trinity College, and in 1938 the School of Forestry was established as a graduate professional school under the direction of Dean Clarence F. Korstian. The Master of Forestry degree was offered initially and later the A.M., M.S., and Ph.D. were offered through the Graduate School. The school has been fully accredited by the Society of American Foresters since 1939.

Dr. Korstian joined the faculty in 1931 as the first director of the Duke Forest. Brought to Durham by Dr. William P. Few, president of Duke at the time, Dr. Korstian set out to develop a "demonstration and research forest" that would serve as a model for owners of small tracts of timber in the South. During this period and for a number of years to follow, research focused primarily on problems of culture, management, and utilization of the softwoods and hardwoods of southern forests.

During the 1930s the faculty of the school was gradually expanded to include a number of research foresters who made substantial contributions to forestry in the Southeast. William Maughan, who specialized in forest management, joined the faculty in 1931. In 1935, Theodore S. Coile, a specialist in forest soils, was added to the faculty. Ellwood S. Harrar, a wood technologist, and Francis X. Schumacher, widely known for his contribution to forest measurements, arrived at Duke in 1937. In 1939, the school rounded out its initial faculty with three distinguished scientists: Roy B. Thomson in economics, James A. Beal in entomology, and Albert E. Wackerman in forest utilization. This faculty established and brought early recognition to the school. Later, faculty were added in silviculture, pathology, physiology, ecology, and biometeorology.

The expanded faculty was soon responsible for shifting the emphasis from southern forestry to research and teaching of forestry with a national and international point of view. Consequently, graduates of the school have found employment in public agencies, forest industries, education, and research in all parts of the nation.

Growing national concern with natural resources and environmental problems led to a new teaching and research emphasis in the 1970s. A new program in natural resource ecology, focusing on ecologically based land use planning, was added to the traditional forest science and management curriculum. In 1974 the name was changed to the School of Forestry and Environmental Studies and a new degree was added, the Master of Environmental Management.

Location

Duke University is situated on the outskirts of Durham, a city of nearly 100,000 inhabitants, in the central piedmont region of North Carolina. The Appalachian escarpment lies approximately 100 miles to the west of Durham and the coastal plain is but a short distance to the east. The school is thus ideally situated near areas of ecological and topographic diversity which offer many opportunities for recreation as well as study.

Piedmont North Carolina is characterized by a rolling, forested topography interspersed with small farms and rural communities in addition to the state's largest cities. The climax forests of the piedmont are hardwoods; however, human disturbance over a period of many years has resulted in the establishment of many forests of the native southern pines. It is in regions like piedmont North Carolina that many of the nonindustrial private forests of the United States are located. These forests are destined to provide much of the increase of wood and wood fiber to be needed by the United States in the twenty-first century.

The southern Appalachians are widely known for their unusual history, picturesque topography, and wide range of flora and fauna. Here the typical hardwood forests which dominate at lower elevations give way to forests of spruce and fir at higher elevations. These forests supply a variety of specialty woods for North Carolina furniture manufacturers and for other industries. The region's numerous recreation areas are widely used for hiking, fishing, skiing, and other outdoor activities.

The coastal plain of North Carolina, already well known for its agricultural production, is now being used extensively by many of the nation's forest industries for plantations of the native pines. The extent of the intensive forestry practices in the coastal plains of North Carolina and other southern states is unmatched elsewhere in the world.

Coastal wetlands and estuaries, now recognized as one of the nurseries of world fisheries, offer abundant and valuable natural resources. North Carolina's Outer Banks and the barrier islands of the other southeastern states serve as protection for these coastal waters. The rapidly increasing population and development in this region make proper management of its natural resources particularly important to the nation.

Because of the school's central location near these regions of vital ecological importance, students are afforded the opportunity to study many current environmental problems in the field. Both the opportunity and the challenge exist to analyze these pressing problems and to develop sound approaches to their management.

Facilities

The School of Forestry and Environmental Studies is housed in the south wing of the Biological Sciences Building on the West Campus. Laboratory and supporting facilities are provided for both teaching and research in all subject matter areas offered in the school. Classrooms and seminar rooms are available in the school

and in other parts of the building. A clubroom, offices, and general study space are provided for students.

Triangle Universities Computation Center. Students and faculty of the school have immediate access to the Triangle Universities Computation Center (TUCC). TUCC is equipped with two IBM 370/Model 165 digital computers which provide the University with computing capability. Access to TUCC is easily accomplished through a medium-speed card reader/line printer terminal in the school. Three keypunch units and a teletypewriter are also available.

Libraries. The combined university libraries, including the main Perkins Library and nine school libraries, contain nearly 3,000,000 volumes. About 150,000 volumes are added annually. Approximately 13,000 periodicals and over 200 newspapers are received. The Biology-Forestry Library, located in the Biological Sciences Building, contains about 125,000 volumes, and receives about 900 periodicals.

Greenhouses and the Phytotron. Adjoining the Biological Sciences Building are excellent facilities for biological investigations under controlled conditions. The phytotron contains fifty separately controlled growth chambers and greenhouses which can be used to grow trees under a variety of environmental conditions. The phytotron is one of only three such facilities in the United States.

The Duke Forest. Approximately 8,500 acres, the Duke Forest is conveniently located for field work. A ten-minute walk from the campus will take one well into many parts of the forest, and roads make all parts of the forest easily accessible. At few other places in America are there provisions for field instruction and research in forestry and environmental problems literally at the door of a large university. This natural outdoor laboratory is an invaluable supplement to the instructional, research, and recreational facilities of the school, the University, and the region.

Duke Forest lies mainly in Durham and Orange counties near the eastern edge of the piedmont plateau. A cross-section of much of the woodlands in the upper coastal plain and lower piedmont of the Southeast is represented in the variety of topographic, soil, forest, and past land use conditions. Elevations range from 280 to 760 feet. The soils are derived from such diverse parent material as metamorphic rock of the Carolina slate formation, granite, Triassic sedimentary rock, and basic intrusives. Nearly 100 tree species are represented.

Duke Forest serves as an outdoor laboratory for study in forestry and allied fields, and as a demonstration of methods of silviculture and forest management applicable to the region. The forest also provides a convenient area to study problems associated with development pressures at the rural-urban interface, and to develop and test educational and recreational programs appropriate for the developing Durham-Raleigh-Chapel Hill metropolitan area.

Research Triangle Park. Numerous industrial and governmental organizations have established research facilities in the Research Triangle Park, ten miles from the Duke campus. Government facilities include the National Environmental Research Center of the Environmental Protection Agency, the Forestry Sciences Laboratory of the United States Forest Service Southeastern Forest Experiment Station, and the National Institute of Environmental Health Sciences of the Department of Health, Education and Welfare. These laboratories provide opportunities for student research and internships in some of the most advanced facilities in the nation.

Neighboring Universities. Through a reciprocal agreement, Duke students may supplement their education in forestry and environmental studies by taking courses in related fields at the University of North Carolina in Chapel Hill, North Carolina State University in Raleigh, and North Carolina Central University in Durham. Graduate students of Duke University and the University of North Carolina at Chapel Hill are granted library loan privileges in both universities.

The Faculty

The faculty of the School of Forestry and Environmental Studies consists of over twenty-five individuals who specialize in various areas of natural resources and the environment. They are committed to excellence in teaching and to the development of meaningful research on current environmental issues facing the nation.

Highly qualified professionals from the United States Forest Service, forestry consulting firms, and other areas of specialization serve as adjunct faculty members. Professors from the Department of Botany at Duke and the Department of City and Regional Planning at the University of North Carolina also hold joint appointments on the faculty. Scholars from foundations, private industry, and government service often visit the school to conduct conferences and symposia, to consult with faculty and students, and to teach special intensive courses. A favorable faculty-student ratio insures small classes, individualized instruction, and careful supervision of independent study.

The faculty is engaged in a dynamic program of research, much of which is oriented toward the analysis of contemporary natural resource and environmental problems. Students are encouraged to assist in these projects to involve themselves in real world situations.

Some of the continuing areas of faculty research are indicated in the faculty listing at the beginning of this bulletin. Several faculty members are also involved in the development of case studies, a new approach to graduate training in resource ecology and management.

The school enjoys close relationships with other professional schools and departments within the University as well as at neighboring institutions. Duke's departments of botany and economics, the School of Engineering, and the Institute of Policy Sciences and Public Affairs, for example, offer courses which are highly complementary to forestry and environmental studies. Faculty from these and other departments and institutions actively cooperate in research projects and sit on the graduate committees of students in the school.

The Students

A typical entering class at the School of Forestry and Environmental Studies consists of approximately seventy students from diverse backgrounds. Students in residence during the 1977-78 academic year represented many geographic areas. Thirty-five were from the northeast United States. Fifteen were from the South, six from the Midwest, and one from the Far West. There were three foreign students. Thirty percent of these students were women and 2 percent were blacks. Their ages ranged from twenty-one to forty, although the majority (66 percent) were twenty-two and under. Twenty-two percent were age twenty-three to twenty-six, and 12 percent were twenty-six and over.

Educational backgrounds of students entering in the fall of 1977 were equally varied. The majority (thirty-three) had undergraduate majors in the natural sciences. Eighteen had majored in either forestry, environmental science, or earth science. Four had majors in social sciences and three in political science. Five had majors in economics, three in business administration, and two in mathematics.

Degrees



Degrees

Duke University offers professional and research degree programs in forestry and environmental studies. Study can be pursued for a Master of Forestry (M.F.) or Master of Environmental Management (M.E.M.) degree in the School of Forestry and Environmental Studies, or for a Master of Science, Master of Arts, or Ph.D. degree in the Department of Forestry and Environmental Studies of the Graduate School.

The degrees offered through the School of Forestry and Environmental Studies (M.F. and M.E.M.) are professional degrees. They are intended mainly to provide students with the education and experience for careers in resource management.

The Master of Forestry degree concentrates on forest and associated resources, including woodlands, water, wildlife, and recreation, and their management from an ecological and economic point of view. The graduate with an M.F. degree is qualified for employment as a professional forester in an administrative, staff, or field position with federal or state agencies, forest industries, and other organizations concerned with forest and land management. The M.E.M. considers natural resources in a broader context. The basic objective of this degree is to develop expertise in planning and administering the management of the natural environment for maximum human benefits with minimum deterioration of ecosystem stability.

Students planning careers primarily in teaching and research are urged to follow a course of study in the Graduate School. The Graduate School degrees (M.S., A.M., Ph.D.) are appropriate for the student who wishes to concentrate on a particular area of resource science or policy, with less emphasis on resource management. These degrees can be structured to include work in professional areas, but a substantial concentration in a specific area of science or of policy is a normal part of a graduate degree.

Requirements for the Professional Degrees

A maximum of 60 and minimum of 30 units are required for either the Master of Forestry (M.F.) or the Master of Environmental Management (M.E.M.) degree. During the student's first semester in residence, the Faculty Council reviews his or her undergraduate records to establish the number of units required for the degree he or she has selected. Appeals to review the decision of the Faculty Council must be submitted to the dean during the first semester. A change in a student's degree



or educational goals will require a re-evaluation of degree requirements. A minimum of 30 units must be completed at Duke and at least two semesters must be spent in residence. The minimum will generally be within range only for students with an undergraduate degree in forestry or environmental studies.

Students entering the school after three years of study in one of the institutions in the Cooperative College Program must complete 60 units in residence. No reduction of unit requirements will be allowed.

Students' programs consist of a combination of regular courses, independent projects, seminars, and modular courses. A master's project of at least 4 but not more than 8 units is required of all students. All students are expected to acquire a basic understanding of resource science, management, and policy. However, considerable latitude is allowed to elect courses to meet individual educational objectives. By judicious selection of courses and independent projects, students can develop in-depth knowledge in one or more areas of study. Course work in other departments of the University and at other institutions in the area is available to strengthen students' education in special areas.

A full semester load is 15 units, which should ordinarily consist of a combination of regular courses, independent projects, and the master's project for not more than 13 units, plus 2 units of seminars or modular courses. Not more than

four regular courses can be taken in a semester. Permission of the dean is required to take more than 15 units in a semester.

As students progress in their programs, they are expected to devote an increasing amount of time to the master's project and to register for more independent project units in a semester. Thus, the student should plan to take fewer units in regular courses during the latter semesters of study.

The modular courses are designed to develop familiarity with identification, measurement, and analysis of natural resources. Some modules emphasize intensive study of a particular ecosystem; others are concerned with environmental and resource measurements. The modular courses offer the opportunity to acquire specific professional skills which are not taught in regular courses. The modules are concentrated in a short span of time during special sessions in August and May, during the regular academic year, and during periods of recess.

All students, except those who have already had equivalent work, begin their study with a four-week session in August which includes several modular courses appropriate for both the M.F. and M.E.M. degrees. Topics in identification of flora and fauna, population parameters, sampling, data analysis, as well as environmental quality determinations, are included. Usually 4 units are earned during this session.

A four-week period in May, after spring semester classes have ended, is also available for earning up to 4 units. Offerings during this period concentrate on resource study and problem analysis in geographic regions significantly different from Durham. The coastal and mountain regions of North Carolina are most often utilized. Special study or research on campus is also possible.

The following courses are required of all students unless course work done elsewhere is found to be equivalent:

Resource Ecology and Ecosystem Analysis (211)	3 units
Resource Economics and Policy (269)	3 units
Quantitative Methods in Resource Management (252)	3 units



CONCURRENT DEGREES

Students desiring to earn both an M.F. and an M.E.M. degree can do so by planning their courses appropriately. The requirements for earning both degrees are as follows:

1. The student must qualify for either an M.F. or M.E.M. degree under the requirements set forth above.
2. To be eligible for the second degree, the student must complete an additional 30 units of study composed of courses which would normally be accepted toward the second degree. Two semesters in residence are required. A maximum of 6 units may be allowed for equivalent graduate work done elsewhere.

Determinations of eligibility for the degrees, including allowances for work done elsewhere, will be made on individual bases only, and will consider the educational background and objectives of the student.

Graduate School of Business Administration. The techniques of management science are applied with increasing frequency in the management of natural resources, and they are also now commonly used in the analysis of environmental problems. To integrate training in these management techniques more effectively into the curriculum, the School of Forestry and Environmental Studies has developed a cooperative arrangement with the Graduate School of Business Administration. Normally three years of study are required to earn the combined degrees of Master of Forestry/Master of Business Administration or Master of Environmental Management/Master of Business Administration. These combined degrees are designed to meet the needs of a wide variety of students. Sequencing of the combined program of study is decided by the student in conjunction with advisers in the two schools. A typical sequence would involve spending the first year in the School of Forestry and Environmental Studies followed by a year in the Graduate School of Business Administration and concluding with the final year in either school with elective work in the other. All students are expected to undertake an internship with a natural resource based firm.

These concurrent degrees stress concepts, analytical reasoning, and the basic methodologies of management science, while providing the student with a knowledge of current problems in the natural resource industries. Managerial economics, resource economics, organization theory and management, accounting, information and control, resource management, the legal environment, and public policy aspects of resource industries form a substantial component of each degree.

Because of the academic demands of these degrees, those entering without the necessary analytical skills or life science background may be required to take additional work beyond that specified.

Students who wish to undertake both the Master of Forestry or Master of Environmental Management and Master of Business Administration degrees must apply to and be accepted by each of the respective schools. For information on the Master of Business Administration degree, the prospective student should write to the Graduate School of Business Administration, Admissions Office, 127 Social Sciences Building, Duke Station, Durham, North Carolina 27706.

Institute of Policy Sciences and Public Affairs. As issues concerning natural resources and the environment have become of increasing significance to the nation, there has developed a corresponding need for well-trained policy analysts who can provide timely and appropriate information and analysis to resource policy makers. To meet this need a unique concurrent degree has been developed in cooperation with the Institute of Policy Sciences and Public Affairs. Students pursue a Master of Forestry or Master of Environmental Management degree and a

Master of Arts degree in public policy sciences. Doctoral candidates in forestry and environmental studies are also eligible to undertake the Master of Arts in public policy sciences.

The concurrent degree normally takes two and one-half years to complete. The first year is devoted to study in the School of Forestry and Environmental Studies, and the second year is spent in the Institute of Policy Sciences and Public Affairs. The final semester involves work in both areas. A summer internship with a resource or environmental agency, or with a related legislative, judicial, or interest group, is required.

This degree provides training in the politics and economics of resource and environmental policy making. Emphasis is placed on understanding the social and political forces involved, developing facility with quantitative and logical methods of forecasting, and evaluating policy consequences. Knowledge of the uses and limitations of policy analysis, and an awareness of the ethical dimensions of policy choice are also stressed.

Students must apply to and be accepted by both the School of Forestry and Environmental Studies and the institute. For detailed information on the policy sciences degree, write to The Institute of Policy Sciences and Public Affairs, Box 4875, Duke Station, Durham, North Carolina 27706.

Degrees in the Graduate School

In addition to the professional degrees (M.F. and M.E.M.) described earlier, Duke University offers the Master of Arts (A.M.), Master of Science (M.S.), and Doctor of Philosophy (Ph.D.) degrees in appropriate areas of forestry and environmental studies. These degrees are administered by the Graduate School of the University; however, the bulk of the instruction, research, and advising connected with them takes place in the School of Forestry and Environmental Studies. For administrative purposes, qualified faculty members of the School of Forestry and Environmental Studies comprise the faculty of the Department of Forestry and Environmental Studies of the Graduate School.

Degrees in the Graduate School are appropriate for students desiring to concentrate their study and research within a well-defined area of forestry or environmental studies. Students usually pursue fewer and more advanced topics to a greater depth than do students in professional degree programs. Thus, study in the Graduate School is more appropriate for students preparing for careers in teaching or research in specialized areas, while the broader approach characterizing professional education is more appropriate for students preferring careers in resource management.

Graduate School students emphasize research as major parts of their degree programs. An active research program is a vital component of the School of Forestry and Environmental Studies, and most of the research projects in the school utilize graduate students as research assistants.

Qualification of Students. Students seeking admission to the Graduate School must have received an A.B. or B.S. degree (or the equivalent in the case of foreign students) from an accredited institution. Usually the student should have majored in the area of intended graduate study or one closely related to it. Some work in science and mathematics is essential; however, the total undergraduate education should be well-rounded. Because research is such an integral part of graduate education and of the school's mission, the student's undergraduate record must evidence the capability and motivation to carry out independent study and research at an advanced level.

Policy and Procedures. Policy and procedures for admission, general requirements for degrees, registration, and academic regulations are given in detail in the bulletin of the Graduate School and are not repeated here. In general, procedures, requirements, and regulations are similar in the Graduate School and in the School of Forestry and Environmental Studies. Some differences are noted below.

Admission. Applications for admission to A.M., M.S., and Ph.D. degree programs in forestry and environmental studies should be obtained from and returned to the Dean of the Graduate School, Duke University, Durham, North Carolina 27706. However, inquiries about programs of study and research should be sent to the director of graduate studies, School of Forestry and Environmental Studies. On request, the director of graduate studies will arrange to have application materials sent to the applicant.

GENERAL REQUIREMENTS FOR THE MASTER'S DEGREES

Residence Requirements. Candidates for A.M. or M.S. degrees must spend, as a minimum, one full academic year (two successive semesters), or its equivalent in summer sessions, in residence at Duke University. Thirty units of graduate credit constitute minimum enrollment for a master's degree. Additional time to complete course and research requirements is frequently necessary.

Transfer of Graduate Credits. A maximum of 6 units of credit may be transferred for graduate courses completed at other institutions. Consult the bulletin of the Graduate School for details.

The Thesis. A thesis is required of M.S. degree candidates. The A.M. degree may be earned with or without a thesis. The thesis must indicate the student's ability to collect, arrange, interpret, and report pertinent material on a research problem. Although a publishable document is not required, the thesis must be written in an acceptable style and should exhibit the student's competence in scholarly procedures.

The Examining Committee and the Examination. The faculty member who directs the student's program recommends an examining committee composed of himself and two other members of the graduate faculty, one of whom usually must be from a department other than forestry and environmental studies. The committee conducts an examination based on the student's general program and on the thesis if one is submitted.

Language Requirements. There is no language requirement for A.M. or M.S. degree candidates in the Department of Forestry and Environmental Studies.

Major and Related Subjects. The student must present acceptable grades for a minimum of 24 units in graduate courses. Of these, at least 12 units must be in the Department of Forestry and Environmental Studies. A minimum of 6 units must be in a minor subject or in related fields approved by the department and by the dean of the Graduate School. A maximum of 6 units may be earned by submission of an approved thesis.

GENERAL REQUIREMENTS FOR THE DOCTOR OF PHILOSOPHY DEGREE

The Ph.D. is a research degree. Although course work is a necessary part of the student's program, the mere accumulation of course credits will not be sufficient for receiving the doctorate. The granting of the Ph.D. is based primarily upon the student's knowledge of a specialized field of study and upon the production of an acceptable dissertation embodying the results of original research.

Requirements. The formal requirements for the Ph.D. degree are as follows: (1) major and related courses, (2) foreign language, (3) a supervisory committee for program of study, (4) residence, (5) preliminary examination, (6) dissertation, and (7) final examination. In order to be considered for candidacy for the Ph.D. degree, the student must have passing grades in all courses and a grade of C or better on at least 9 units.

Major and Related Courses. The student's program of study demands substantial concentration on courses in the department. However, a minimum of 6 units in a related field approved by the department must be included.

Foreign Language. Ph.D. candidates in forestry and environmental studies are ordinarily expected to have a reading knowledge of one foreign language. However, on recommendation of the student's supervisory committee, knowledge of a second language may be required. In exceptional cases, the language requirement may be waived completely.

Supervisory Committee. As early in a student's course of study as is practicable, and not later than two months before the preliminary examination, the director of graduate studies will nominate for the approval of the dean a supervising committee consisting of five members, with one member designated as chairman. This committee will include at least three graduate faculty members from the department and at least one from outside the department. This committee, with all members participating, will determine the program of study and administer the preliminary and final examinations. Successful completion of the final examination requires four affirmative votes. The final examination may be administered by four members if the representative of the related field is present.

Residence. The minimum registration requirement is 60 units of graduate credit, of which not more than 30 units may be accepted by transfer. Since a full program is 30 units per academic year, prospective Ph.D. candidates who enter with the A.B. or B.S. degree must plan to spend in residence a minimum of two academic years; if they enter with the A.M. or M.S. degree, their minimum residence is one academic year. All students must register for a full course load until they pass the preliminary examination. Those entering with undergraduate deficiencies may be required to take undergraduate courses for which they will not receive degree credit. The student's supervisory committee will determine what requirements above the minimum, if any, the student must meet.

More complete information and requirements for the preliminary examination, the dissertation, and the final examination are outlined in the bulletin of the Graduate School.

Programs of Study and Research



Duke's School of Forestry and Environmental Studies emphasizes three comprehensive areas of study and research: *science, management, and policy* of natural resources and the environment. Students are expected to gain some experience in each of the three areas. In addition, each student is expected to define his or her educational goals and to enter a sequence of courses and research designed to achieve these goals. For most students, well-defined goals lead to specialization in a particular area of graduate-professional study in resources and the environment. Specialization is not required. However, the experience of many graduates of Duke and other schools has indicated that employment opportunities are enhanced by the graduate's ability to identify specific skills acquired during graduate-professional education.

Some students prefer to design individualized programs of study based on their previous education, work experience, and professional goals. For example, the student, with the help of his or her adviser, may tailor a program to emphasize areas of study such as land suitability analysis, regional resource planning, coastal management, or environmental protection strategies. Other students prefer to enter one of the school's more structured programs of study and research in forest protection, resource operations management, modeling and information systems, or ecology. These special programs are designed to develop the student's competence in a more narrowly defined area and, at the same time, to assure educational breadth.

Except for the student with an undergraduate background in an appropriate area of natural resource and environmental studies, these programs of concentration normally require two years for completion of the master's degree. All programs include the three core courses required of all students registered in the school, FES 211, FES 269, and FES 252. Several courses in the area of specialization, elective courses, and the master's project complete the requirements. In addition, students are expected to participate in a seminar appropriate to the program during each semester of residence. An internship with a public agency or resource based industry may be used for a part of the academic credit.

Each of the programs allows the student to select courses and research projects within the areas of concentration to meet his or her specific needs and interests. Because of the variety of options within each program, the student should freely consult his or her adviser as well as members of the faculty who are associated with a particular area of specialization to determine proper selection of courses and to identify a topic of research for the master's project. Through careful planning, the student is able to acquire a unique identity and level of expertise that can substantially increase career opportunities upon graduation.

The programs of study and research in forest protection, resource operations management, resource modeling and information systems, and resource ecology are described below. More detailed descriptions are available from the school office.

Forest Protection Program. A transition in forest protection beyond the nearly exclusive dominion of fire prevention and suppression began in 1960 when insect and disease management was implemented in the United States Forest Service and many state agencies under mandate of the Forest Pest Control Act of 1947. Accordingly, a rising demand for forest protection specialists was foreseen and the Forest Protection Program at Duke University was created in 1965 to help meet this need. A decision then to emphasize the integration of forest entomology and pathology has proved successful. The program remains unique to this day in that few other universities offer such a dual concentration. Thus, Duke's graduates are highly competitive for the few professional openings that surface each year. It is likely that the demand for protection specialists will be sustained and perhaps increased in the future as forest management practices and urban tree care intensify.

The program of specialization in entomology and pathology is designed for students desiring career preparation in the theoretical and applied aspects of forest insect and disease control. A science base in entomology, plant pathology, and related disciplines is developed and applied to the managerial aspects of insect and disease detection, evaluation, prevention, and suppression.

In dealing with the impact and suppression of insects and diseases upon the forest resource, the program utilizes courses which explore these interacting components in terms of (1) taxonomy and biology, (2) ecological behavior, and (3) quantitative assessment. It consists of an introductory resource core, a protection specialization, science options in entomology and/or pathology, and electives. This program of study leads to the Master of Forestry degree.

Students entering the Forest Protection Program should have either a bachelor's degree in forestry or substantial preparation in the life sciences and at least a minimal background in economics and mathematics.

Resource Operations Management Program. Specialization in resource operations management provides the educational basis for careers in the management of personnel, capital, materials, and information systems to produce and deliver the primary goods and services of a resource based operation. Because such an operation must carefully protect its resources as well as manage the many physical systems necessary for the production of its goods and services, problem solving is an essential skill. As in other organizations, the competitive performance and overall contributions of a resource based operation are highly dependent on effective management. Through the study of management sciences and methods of problem analysis, students in the program develop the background for a wide range of employment opportunities in resource based industries, in the management of public and privately owned timber lands, in consulting, and in other areas of resource management.

The program encompasses three broad areas of subject matter: (1) the characteristics and biophysical behavior of the forest resource, (2) applied economics and related methods of problem analysis, and (3) a variety of computer based, quantitative methods. Students may elect courses for further specialization in resource science, management, policy, or measurements, or in another area of interest. For example, accounting, finance, and organization behavior are areas of education basic to the background of a resource operations manager. Courses in marketing, international relations, business policy, managerial economics, personnel, and business law can be highly desirable for those planning to enter industrial



forestry. Students in the program may pursue either the Master of Forestry, the Master of Environmental Management, or the Master of Science degree. Many students in the program also earn a concurrent degree in the Graduate School of Business Administration.

Students entering the Resource Operations Management Program should be well prepared in ecology, economics, and quantitative methods. One course in statistics and two in calculus are recommended.

Resource Modeling and Information Systems. The advent of the modern high-speed digital computer has made it possible to develop sophisticated models of resource systems utilizing concepts from several branches of applied mathematics. Modeling is based on a systems concept that is applicable to many levels of organization in natural resources. For example, the natural resource modeler may be required to simulate a timber harvesting system, the behavior of insect populations in a forested region, mineral cycling in wetland ecosystems, a hydrologic system, or an exploited animal population. Once a system is clearly defined and models formulated for its representation, the researcher can establish a procedure for sound, imaginative analysis.

The Resource Modeling and Information Systems Program emphasizes analysis of natural resource and environmental systems through the construction and manipulation of models and use of the computer. Methods of collecting, storing, and analyzing data, computer system design, and the integration of software and hardware systems form a basic part of the program. Consequently, students who elect this area of specialization should be well grounded in basic mathematics or be prepared to develop the necessary competency in the early stages of graduate study.

Students entering this program may pursue either the Master of Forestry, the Master of Environmental Management, or the Master of Science degree. A

judicious choice of electives will allow the student to meet the requirements relevant to the particular degree. Because the program provides excellent preparation for persons desiring careers in teaching and research, those entering the program should give serious consideration to the completion of the Ph.D.

Resource Ecology. The Resource Ecology Program focuses on problem solving in the ecosystem with emphasis on factors influencing a particular natural resource or system of natural resources. The philosophy of the program is to utilize the scientific method in solving applied environmental problems, to develop new ecological concepts and methods appropriate to solving these problems, and to create a useable body of knowledge for the environmental management and policy disciplines. Through careful selection of electives, students in this program may earn either the Master of Forestry, the Master of Environmental Management, or the Master of Science degree. Students interested in a career in teaching or research should plan to complete the Ph.D.

The program emphasizes six major areas of study: (1) applied systems ecology/systems simulation, (2) exploited populations/animal ecology, (3) physiological ecology (animal or plant), (4) resource ecology/ecosystem analysis, (5) terrestrial/forest ecology, and (6) water resources/aquatic ecology. Students in the program must select a minimum of one course from four of the six areas of emphasis and complete a master's project of 4 to 6 units of credit in one of the areas.

Students who enter the Resource Ecology Program should have a bachelor's degree in a pure or applied science which emphasizes quantitative methods. Biology, chemistry, engineering, environmental studies, geology, mathematics, and physics all provide excellent undergraduate backgrounds. Courses in ecology and quantitative methods are prerequisites for full acceptance into the program.





Center for Resource and Environmental Policy Research



Director

Gerald R. Stairs, *Professor*

Faculty

Frank J. Convery, *Associate Professor*

George F. Dutrow, *Adjunct Associate Professor*

Milton T. Heath, *Adjunct Professor*

R. Rajagopal, *Assistant Professor*

Curtis J. Richardson, *Associate Professor*

Jack P. Royer, *Assistant Professor, Research Associate*

William A. Thompson, *Assistant Professor*

The Center. The Center for Resource and Environmental Policy Research recently established at Duke University is committed to objective and timely analyses of critical natural resource and environmental issues in need of policy formulation. Emphasis is given to land, forest, water and air resources, and to energy. The center's agenda includes problems characteristic of the managed forests of the Southeast, the coastal zone, and the recreational lands of the Appalachian region. However, the interests of the scholars and students associated with the center are not limited to the Southeast. Rather, policy issues of national, and sometimes international, flavor are the subject of investigation.

The center was developed in response to recognition of the many conflicts developing over competitive use of natural resources and consequent legislative regulation. Clearcutting of national forests, timberland taxation policy, and land use in coastal zones are indicative of the types of resource-environmental issues that have elicited concern.

During the past few years, a substantial and comprehensive body of legislation has been enacted to address resource and environmental problems, much of it strongly influenced by information provided by special interest groups. Often, this legislation has been drafted and passed in a quasi-crisis atmosphere with a consequent absence of mature deliberation.

Because contemporary resource-environmental problems are deeply embedded in the social, economic, and political fabric of the country, they are in need of careful and deliberate study. It is in the national interest that such issues be examined in a setting conducive to independent thought with appropriate regard for timeliness of results and conclusions. A university is one of the few places that can provide the proper setting for such an approach. The Center for Resource and

Environmental Policy Research at Duke University is designed specifically to accomplish these goals.

Among the objectives of the center are:

1. Ex post facto evaluations of resource-environmental policies to examine achievement of goals and performance from technical, efficiency, equity, and political viewpoints;
2. Policy research on contemporary problems to provide results for policy-making groups in federal, state, and local governments;
3. Identification and research of issues of potential importance to formulate a set of policy alternatives.

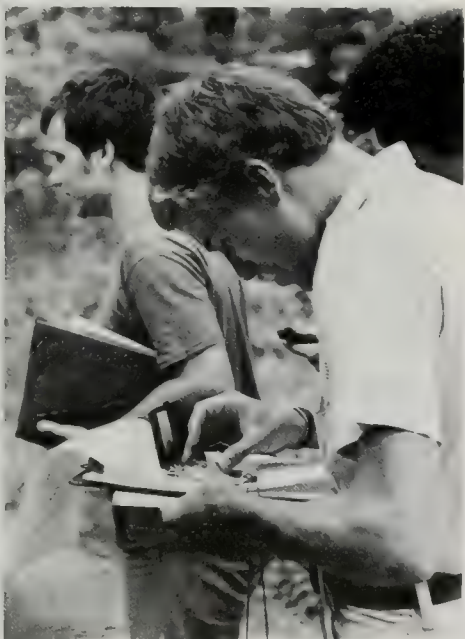
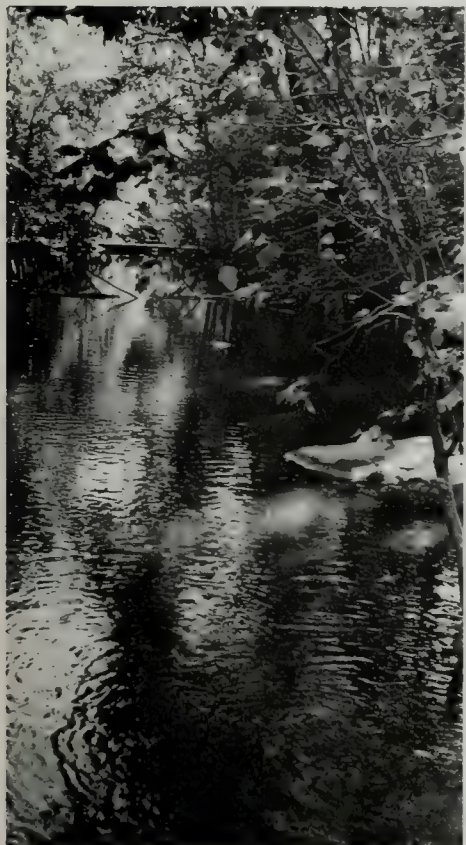
The center communicates the results of its research to the appropriate governmental bodies by a variety of means—conferences, symposia and seminars, liason with government officials, appearances before congressional committees, and a bulletin series.

Faculty. Housed in the School of Forestry and Environmental Studies, the center is headed by a director and includes a small, permanent faculty in addition to a much larger number of visiting scholars, professionals, and scientists.

Scholars and scientists from other universities, industry, government, foundations, and private research laboratories are invited to participate on a short- or long-term basis depending on the nature of the problem under study. Practitioners from the professions of law, business, forestry, natural resources, and engineering also participate in the center's research projects.

The permanent faculty of the center is drawn largely from the School of Forestry and Environmental Studies. Adjunct faculty from other schools and departments at Duke and neighboring universities contribute to its research programs. Duke's School of Law, Institute of Policy Sciences and Public Affairs, Graduate School of Business Administration, and School of Engineering support the research of the center.

Students. The center is oriented almost entirely toward research on critical resource-environmental issues. Consequently, the center offers no degrees. It is the opinion of the center's faculty that the research can best be accomplished by drawing on the skills of graduate and professional students from many parts of the University and nearby educational institutions. For example, graduate students registered for A.M. or Ph.D. degrees in economics, engineering, political science, and policy sciences and public affairs are retained as research assistants. Similarly, students registered in the professional schools of the University, such as forestry and environmental studies, law, or business administration, are also involved in the center's research projects.



Other Features



Cooperative Colleges

The Cooperative College Program is designed to coordinate the education of students in selected undergraduate schools with graduate programs in the broad area of resources and environment offered at Duke. Students are accepted for either of two degrees, the Master of Forestry (M.F.) or Master of Environmental Management (M.E.M.). Although the program is designed to accommodate a wide range of undergraduate backgrounds, experience of several years indicates that it is best suited to majors in one of the natural or social sciences, pre-engineering or business, natural resources, or environmental science.

The program accepts students after three years of undergraduate study or upon completion of the baccalaureate. With appropriate guidance, highly qualified students can reach a satisfactory level of preparation for graduate work at Duke in three years of coordinated undergraduate study. The baccalaureate degree is awarded by the undergraduate school after the student has earned enough units at Duke to satisfy the requirements of the undergraduate institution. Minimum time required to complete the bachelor's degree is two full-time semesters at Duke. After an initial session in August and four semesters at Duke, in which a minimum of 60 units of credit is earned, students may qualify for one of the professional master's degrees.

Other students may prefer to complete the baccalaureate degree before undertaking graduate study at Duke. The master's degree requirements for these graduates are the same as those for students entering Duke after three years, but the 60-unit and total residence requirements may be reduced if the student has completed relevant undergraduate work of satisfactory quality. All requirement reductions are determined individually, considering both the student's educational background and educational objectives. In all cases, however, the minimum requirements at Duke for a master's degree are 30 units of credit and two semesters in residence.

A student interested in entering the Cooperative College Program should apply to one of the participating schools. Each can provide information on courses of study and bachelor's degree requirements. Students applying for admission to Duke after the third year of study should do so early in the first semester of the third year. Students applying for admission after completion of the baccalaureate should return completed application materials by 15 February.

Internships

An internship with a public agency, a forest industry, or other private firm can be a valuable part of graduate professional education. Interested candidates for either professional degree may arrange an internship of three to six months' duration. The student is required to spend at least two full semesters in residence at Duke prior to accepting an internship and must return to the University for at least one full semester following completion. Up to 12 units can be earned for an internship; however, in order to receive credit, planning well in advance and approval from the adviser is required. A paper on the internship must be submitted to the adviser before completing the final semester at Duke. The internship must contribute substantially to the educational objectives of the student. With approval, students may use a part or all of the intern experience to fulfill the master's project requirement.

Intensive Courses

Intended for both practicing professionals and full-time students who are pursuing careers in resource management, policy, and environmental science, the intensive courses offer an alternative to traditional full-semester courses. The sessions are designed to allow regular students to blend theory with practical experience as well as to allow experienced professionals to update theory and methodology. Recognized subject matter specialists provide instructional resources not normally available to the University. The result is an enriched educational experience through the exchange of ideas and information by participants of diverse backgrounds.

The intensive courses are organized into week-long modules and classes are held three hours a day during the week. A course consists of one, two, or three modules, each a discrete unit of study. Students earn the equivalent of 1 unit of graduate credit for each module.

Recent courses have dealt with the following topics: economics of intensive forestry, economics of fire management, property law and land use planning, natural resource law, environmental law, forest land appraisal, legislative regulation of private forest practices, regional resource planning, and forest taxation.

Complete information on the intensive courses to be offered during a semester may be obtained from the school office.

Integrated Case Studies in Natural Resource Analysis

Educational and research opportunities to participate in integrated case studies are available to qualified students who wish to utilize the interdisciplinary team approach to environmental problem solving.

The integrated case study is an exploration of the full ramifications of utilizing a particular natural resource or system of natural resources under the direction of a team of researchers. The research team represents varied interests and skills in resource-ecology, economics, management, and policy.

The case study approach to graduate education affords the student an opportunity for real world problem solving. With the supervision of the research team, the student develops and tests methodologies for solving an actual resource problem. Through the dissemination of the research data to appropriate potential user groups, the case study provides decision makers with a holistic analysis of the resource problem along with a series of alternative solutions.

Up to 12 units of credit may be earned for a case study. In order to receive credit, the student must submit a written research proposal to the case study

director and present a written report for approval before completing the final semester of study at Duke. Financial assistance is available to qualified students for the preparation of case studies.

Publications

The Office of Resource and Environmental Publications serves as the center of publications by the School of Forestry and Environmental Studies. The office is under the direction of an editorial assistant with students assigned to provide a variety of services as needed. Regular publications include a school news magazine, announcements of intensive courses and conferences, a student resume book, and an annual research report. Technical bulletins and conference proceedings are issued as part of a continuing series.

FOREM (an acronym for forest, resource, and environmental management) is the news magazine for alumni and friends of the school. Its purpose is to reflect all aspects of the school's current activities and achievements, with an emphasis on research efforts. Special sections include faculty briefs, student and alumni association news, and class notes. *FOREM* is mailed to alumni of the school and to other interested individuals and businesses throughout the United States upon request.

The student resume book is issued annually as a means of directing attention to graduates of the school and helping them to secure employment. Students are strongly urged to prepare resumes, with the help of the staff, for the publication. The book is sent to a wide range of potential employers in public and private sectors.

Scheduled for publication in the late summer of each year, the annual research report gives a detailed description of research carried out during the past fiscal year by faculty and students. The report is intended for use by researchers in the resource and environmental field as well as by other individuals interested in research activity at the school.

A series of technical bulletins and papers has been published by the school since its establishment. Topics in this series range from plant competition in forest stands and forestry on private lands, written by Clarence F. Korstian, the school's first dean, to contemporary forest management practices and water resources information.

Most of the publications in the technical bulletin series are available and may be purchased from the school office. *FOREM*, the student resume book, and the annual research report are available free of charge.

Placement



The School of Forestry and Environmental Studies operates its own placement services. Facilities are available to assist students in finding internships following completion of the first year of study, summer employment, permanent employment upon graduation, and mid-career changes of employment. Individual career counseling is provided informally by the faculty and staff, student groups, and visitors to the school. Workshops are held to assist students in the development of job search skills, interviewing techniques, and resume preparation.

The school maintains a list of employment opportunities in a broad range of industrial firms, various branches of local, state, and federal government, universities, and other nonprofit organizations. Each year representatives of a number of firms and government agencies from throughout the country visit the school to interview degree candidates. Many alumni, almost all of whom are employed in resource or environmental management, maintain close contact with the school in search of graduates who can fill positions in the organizations which they represent.

An important feature of the placement service is the resume book published annually and distributed to potential employers. Students are strongly encouraged to prepare and submit resumes, with the assistance of the staff, for publication. Employer response to the resume book has been favorable, and many students have received initial contacts and invitations to interviews as a result.

Students are also encouraged to submit a short resume for publication in *FOREM*, the news magazine issued by the school. These resumes of fifty- to sixty-word length provide the degree candidate as well as the student seeking summer employment with exposure to over 3,000 individuals and agencies which receive *FOREM* on a regular basis.

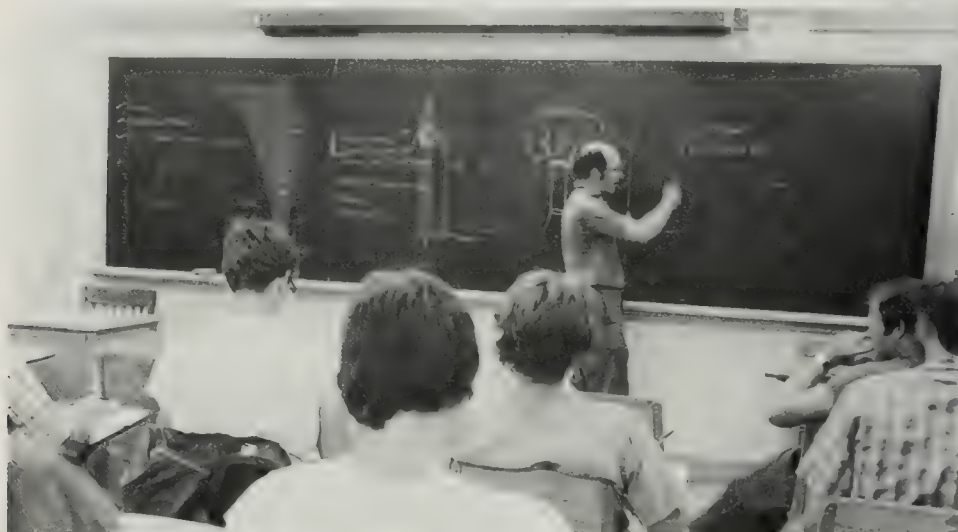
Additionally, students may register with the University's Office of Placement Services, 214 Flowers Building.

The success experienced by degree candidates in securing employment is strong testimony to the value of graduate/professional study at Duke. Virtually all candidates find satisfying employment upon graduation, and each year a number receive multiple job offers. Beginning salaries vary widely depending upon the educational specialization, capabilities, and prior experience of the candidate as well as the type of organization and geographical region in which he or she is employed. For recent graduating classes, beginning salaries have ranged from \$12,500 to \$18,000 annually with candidates having some prior experience commanding the higher figures.

Traditionally, the major employers of forestry graduates have been educational institutions and the United States Forest Service. However, a recent survey of

Duke's School of Forestry and Environmental Studies graduates revealed some important changes in employment patterns. Since 1970, the percentage of graduates entering the fields of education and government forestry has decreased dramatically. Although some graduates still enter these fields, a far greater number now enter management, administration, or research in forest products, paper, and chemical manufacturing firms. An increasing number of graduates are becoming involved in research, planning, and management for state or county forestry commissions, natural resources departments, conservation commissions, and for federal protective agencies. Several alumni are consultants for private concerns. Others are researchers or consultants for international organizations, public and private, and a few are in forest services in foreign countries.

Throughout the forty years since the school's establishment, many of its graduates have achieved positions of significant responsibility in both public and private sectors, a continuing demonstration of Duke's reputation for excellence.





Admissions



The student contemplating study at Duke in natural resources and the environment can enter either the School of Forestry and Environmental Studies or the Graduate School. Admissions procedures differ somewhat depending on the choice of degrees. The professional degrees, consisting of the Master of Forestry (M.F.) and Master of Environmental Management (M.E.M.), are administered by the School of Forestry and Environmental Studies. Students wishing to earn either of these professional degrees should apply directly to the school. Those preferring to earn a Master of Science (M.S.), Master of Arts (A.M.), or Doctor of Philosophy (Ph.D.) degree should apply to the Graduate School. Students contemplating study for the Ph.D., but who are undecided at present, may find it desirable to complete one of the professional master's degrees in the school (M.F. or M.E.M.) and apply to the Graduate School for admission to the Ph.D. program at a later date.

Admission to the School of Forestry and Environmental Studies

The School of Forestry and Environmental Studies welcomes applications from men and women of all backgrounds who seek an intellectually challenging education designed to prepare them for leadership in a wide variety of natural resource and environmental positions. The programs do not require previous study in forestry or environmental studies. However, they are designed primarily for students with a degree in one of the natural or social sciences (including chemistry, biology, physics, economics, earth sciences, environmental sciences, mathematics, and political science) or a preprofessional area such as forestry, engineering, or business.

Admission is open to men and women who hold a bachelor's degree from an accredited college or university or who have completed at least three years of study in an institution participating in the Cooperative College Program. Students who do not have a bachelor's degree and are not enrolled in one of the cooperative colleges may apply to the school for special eligibility. Special eligibility is granted in a limited number of cases to individuals who can meet the school's admission criteria and who have completed the equivalent of 90 semester hours of acceptable undergraduate credit. Those interested in consideration for special eligibility must receive approval from the director of admissions before submitting an application.

Admission as a special or nondegree student may also be granted under appropriate circumstances.

Recommended Preparatory Courses. Course work in the School of Forestry and Environmental Studies is taught at a level which assumes that students have had at least one year of biology, economics, and college-level mathematics. In addition, one course in ecology is highly desirable. Preparation in biology should include some work in botany. Courses in economics should have a significant component of microeconomics. Preparation in mathematics should include courses in statistics and calculus. Since considerable emphasis is placed on use of the computer during graduate study at Duke, course work in computer science can be valuable.

Although students without the level of preparation described above may be accepted for admission, it is expected that deficiencies will be made up prior to entrance by means of formal course work, independent study, or other arrangements agreed upon by the applicant and the school. Students entering the school in August may find it desirable to take preparatory courses in the summer session at Duke.

Preparation beyond that described above is highly desirable for students entering specific programs. For example, students who choose to enter the Resource Ecology Program are advised to complete additional course work in the natural sciences including chemistry, ecology, physics, earth sciences, and mathematics. Those who choose to enter the Resource Operations Management Program should obtain additional undergraduate education in economics, business, and mathematics. Students who enter the Forest Protection Program should be particularly well prepared in biology and chemistry.

Admission Criteria. Admission to the School of Forestry and Environmental Studies is highly selective. Academic performance as an undergraduate, scores on the Graduate Record Examinations, and full-time work experience are the primary factors. Recommendations, the statement of educational goals, extracurricular activities, part-time and summer work experience, and other information requested on the application also provide a basis for selection.

The Admissions Committee considers each applicant as an individual. It attempts to evaluate each candidate for his or her academic potential, professional promise, and ability to benefit from and contribute to the goals of the school.

Application Procedures. Except in unusual circumstances, students are admitted only at the beginning of the four-week program in August or at the beginning of the fall term. Applications are accepted at any time; however, applications which include requests for financial aid must be submitted by 15 February preceding the summer or fall in which admission is desired. Because the school processes applications from more qualified students than it can admit, early submission of applications is recommended.

Application for admission to the Master of Forestry and Master of Environmental Management degrees is made through the Office of Admissions of the School of Forestry and Environmental Studies. All correspondence should be addressed as follows: Director of Admissions, School of Forestry and Environmental Studies, Duke University, Durham, North Carolina 27706.

Each applicant must submit the following before action can be taken:

1. application form;
2. transcripts from each undergraduate and graduate school attended;
3. three letters of recommendation;
4. scores on the aptitude (verbal, quantitative, and analytical) test of the Graduate Record Examinations;
5. a nonrefundable application fee of \$20.

Application Forms. No applicant will be considered until the completed application form and related documents are received by the director of admissions. The Admissions Committee attaches considerable weight to the statement of educational objectives submitted by the applicant. This statement should reflect well-defined motivation to pursue graduate study. The school is particularly interested in applicants who show leadership potential in the broad field of natural resources and the environment. Applicants are expected to demonstrate the maturity and sense of purpose essential to a demanding educational experience, including a concept of the value of professional education to the applicant's career plans and expectations.

Transcripts. Official transcripts of all undergraduate and graduate study should be sent directly to the director of admissions by the registrar of each institution attended.

Letters of Recommendation. Each applicant is required to arrange for the submission of three letters of recommendation, preferably on the form supplied with the application. These recommendations provide the Admissions Committee with evaluations of the applicant's past performance in academic and employment related situations. Although recommendations from any source are acceptable, at least one job related recommendation and one from a college instructor or administrator are desirable.

Graduate Record Examinations. All applicants for degree programs must take the aptitude test (verbal, quantitative, and analytical) of the Graduate Record Examinations (GRE). Although not required, applicants are encouraged to take an advanced test and submit the score as additional information for admission. The GRE is administered by the Educational Testing Service at locations throughout the world. Applicants are urged to take the exam at the earliest convenient date. Scores on tests taken later than October may not reach the school until after the 15 February deadline for application for financial aid. Scores should be reported directly to the director of admissions. Registration forms may be obtained by writing to GRE, Educational Testing Service, Princeton, New Jersey 08540.

Interviews. An interview with a member of the Admissions Committee, although not required, often is helpful to the applicant as well as to the school. Consequently, those applicants who can visit the school are encouraged to do so. The interview presents an excellent opportunity for the applicant to ask questions, gain insight into the school, and bring items of concern to the attention of the Admissions Committee. Applicants are encouraged to allow sufficient time to visit classes, meet students and faculty, and tour the University and Duke Forest.

In general, interviews can be scheduled on weekdays throughout the academic year. Appointments should be made at least two weeks in advance. Visits during the summer months are possible but should be scheduled well in advance.

Each year faculty or other representatives of the school travel throughout the country to visit undergraduate schools, particularly the cooperative colleges. Applicants from cooperating colleges should check with their program adviser for details of these visits. In addition, it is sometimes possible to arrange an interview with an alumnus, particularly where distance precludes travel to Durham. In all of these situations the emphasis is on exchanging information with the applicant.

For further information or to arrange an interview, applicants may write to the Office of Admissions or call (919) 684-2802.

Application Fee. A nonrefundable application fee of \$20 is required of all applicants. A personal check, money order, or cashier's check made payable to Duke University is acceptable. Applications will not be officially received or processed until the required fee has been paid.

Deferred Admission. Normally, applicants are admitted only to the class for which they have applied. However, a deferral of admission may be granted for the applicant to gain experience or to strengthen academic qualifications for graduate study or for other valid reasons. Except in unusual circumstances, a deferral of admission cannot be granted for more than one year. Deferrals are granted on individual bases. The small size of each class frequently precludes open-ended guarantees of future admission; however, applicants with substantial reasons for deferring the start of graduate work are encouraged to send a request to the director of admissions as soon as possible after receiving an offer of admission.

Application Deadlines. Application forms and all other information required to complete the application and to allow a student to be considered for admission should be submitted to the Office of Admissions by 15 February for the August or fall terms and by 15 October for the spring term. Although applications submitted after these dates may be considered, early application is recommended because the school receives applications from more qualified students than can be accommodated. All candidates should make arrangements to complete the Graduate Record Examinations well in advance of these deadlines. Applicants seeking financial assistance in the form of scholarships, fellowships, and assistantships for the fall term must have their applications completed no later than 15 February.

Response to Offer of Admission. When admission is approved, the applicant will receive an offer of admission and an acceptance form. A nonrefundable tuition deposit of \$50 is required with acceptance of the offer. The admission process is not complete until the acceptance form and the tuition deposit have been returned to the director of admissions.

Additional Procedures for Foreign Students. Each year the School of Forestry and Environmental Studies welcomes a number of foreign students among its professional and graduate candidates. Applicants from other countries must meet the same criteria as applicants from the United States. All academic transcripts and other documents in support of admission must be accompanied by an official translation if the original document is not in English. The nonrefundable application fee of \$20 (U.S.) must accompany the application. Applicants must have a fluent command of oral and written English. No allowance is made for language difficulty in arranging course schedules or in evaluating performance.

If the native language is not English, the applicant must submit scores on the Test of English as a Foreign Language (TOEFL) to be considered for admission. All arrangements for taking the TOEFL must be made directly with the Educational Testing Service, Box 899, Princeton, New Jersey 08540.

All foreign students whose native language is not English will be tested during their first registration period for competence in the use of oral and written English. Until such competence is determined, admission and arrangements for an award involving teaching must remain provisional. Students found to lack necessary competence should be prepared to assume all costs for being tutored in English and should reduce their course or research program by 3 units while being tutored. Students who do not successfully pass the test for competence in the use of oral and written English by the end of their first year of residency will not be permitted to continue their graduate work at Duke University.

Foreign students are not eligible for federal or state loans. The visa-granting authority in the student's country of origin, ordinarily the United States Embassy, requires proof that sufficient funds are available to the student to cover the expenses of all academic years of study before a visa can be granted. Current immigration laws make it extremely difficult for the foreign student to find summer employment and/or permanent employment in the United States after graduation.

Admission to the Graduate School

Applications for admission to M.S., A.M., and Ph.D. degree programs in forestry and environmental studies should be obtained from and returned to the Dean of the Graduate School, Duke University, Durham, North Carolina 27706. However, initial inquiries and questions concerning fields of study are best directed to the Director of Graduate Studies, School of Forestry and Environmental Studies.

Policy of Nondiscrimination

Duke University does not discriminate on the basis of race, color, national and ethnic origin, sex, or handicap in the administration of educational policies, admission policies, financial aid, employment, or any other University program or activity. Inquiries concerning the University's responsibility may be directed to the director of equal opportunity.

Financial Information



Tuition and Fees

The cost of graduate study in the School of Forestry and Environmental Studies at Duke is met primarily from income from endowment, gifts, grants, and research contracts. Substantially less than one-half of the total cost is covered by tuition. In general, the cost of a graduate education of the quality offered by Duke University is modest in comparison with that of other private institutions.

Estimated Expenses for the Academic Year.* Certain basic expenditures, such as tuition and housing, are to be considered in preparing a student's budget. The following approximate costs assessed in 1978-79 are indicative of costs that can be expected in 1979-80:

Tuition (\$127 per unit)	\$3,810
Student health fee (\$53.50 per semester)	107
Housing	800
Food	800
Books and supplies	200
Motor vehicle registration	
——automobile	20
——motorcycle	10
Optional athletic fee	25

In addition to these necessary expenses, the student will incur others which will depend to a large extent upon the tastes and habits of the individual. The average Duke student, however, can plan on a budget of approximately \$6,000 for the academic year. Travel costs, clothing purchases, and other major expenditures are to be added to this estimate. Students with families naturally will have higher expenses.

Tuition Refund Policy. Tuition refunds are governed by the following policy:

1. In the event of death or a call to active duty into the armed services, tuition is refunded on a pro rata basis.
2. In all other cases of withdrawal, students or their parents may elect to have tuition charges refunded or carried forward as a credit for later study, according to the following schedule:
 - a. Withdrawal before the beginning of classes: full refund.
 - b. Withdrawal during the first or second week of classes: 80 percent.

The figures contained in this section are subject to change prior to the beginning of the fall, 1979, semester.

- c. Withdrawal during the third through fifth week: 60 percent.
- d. Withdrawal during the sixth week: 20 percent.
- e. No refunds after the sixth week.
- f. Tuition or other charges paid from grants or loans will be restored to those funds, not refunded or carried forward.

Late Registration. Students who register at a date later than that prescribed by the University must pay a fee of \$25 at the bursar's office.

Audit Fee. A student who registers and pays fees for 12 units or more may audit one course without charge. To audit more than one course or if auditing and registered for less than 12 units, the audit fee is \$40 per course.

Transcripts. Transcripts are available on request for a fee of \$2, payable in advance, for a single copy. Additional copies to the same address are fifty cents.

Housing Charges. The cost for each person in a double room for the academic year is \$622 in Trent Drive Hall. Rent at Town House Apartments is \$764 per student for the academic year on the basis of three students to an apartment. The rent is \$1,100 per person if only two persons share the apartment. Utility charges are not included in the rent.

Central Campus Apartments rents are: \$1,711 for an efficiency; \$1,301 per person in a two-person, two-bedroom unit; and \$1,105 per person in a three-person, three-bedroom unit. Rent does not include phone but does include other utilities. These rental fees are in effect for the academic year. Proportional increments are charged for year-round occupancy.

Modular homes rent for \$950 per person in three-bedroom units. Utilities are not included.

Housing costs are subject to change prior to any academic year. A \$50 deposit is required with all housing applications. The deposit is refunded if there is no room or if the applicant declines the space offered prior to 15 July.

Motor Vehicles. Motor vehicles parked on campus must be registered with the traffic office. Registration must be completed five days after operation on campus begins. The proper registration decal should be displayed on the vehicle. A registration fee of \$20 is charged for each automobile and \$10 for each motorcycle.

The following documents are required to register a vehicle: (1) valid state registration for vehicle registered, (2) valid state operator's license, and (3) satisfactory evidence of automobile liability insurance coverage with limits of at least \$10,000 per person and \$20,000 per accident for personal injuries and \$5,000 for property damage, as required by the North Carolina Motor Vehicle Law.

Optional Athletic Fee. For the optional athletic fee, the student obtains admission to all regularly scheduled University athletic contests held on the University grounds during the academic year. This fee is payable at the beginning of the fall semester.

Debts. All charges for each semester are due and payable not later than the date specified by the University. No student can complete registration or attend class until arrangements have been made with the bursar for the settlement of debts. No records are released and no student is considered by the faculty as a candidate for a degree until all debts are settled with the bursar.

Financial Assistance

Financial assistance in the form of scholarships, fellowships, or assistantships is available for qualified students pursuing either the professional degrees (M.F. or M.E.M.) or the graduate degrees (A.M., M.S., or Ph.D.). Typically, a student may

be offered either a scholarship or fellowship (to defray a part of the tuition) and an assistantship.

Scholarships are granted from University funds which are in limited supply. Consequently, only well-qualified students can expect to receive awards. Scholarships are awarded on the basis of demonstrated outstanding academic ability and a high degree of professional promise. Most scholarship funds are awarded to students entering in the fall semester. Scholarships are nontaxable.

Fellowships are obtained from foundation grants, private industry, or individual donors. Donors of fellowship funds sometimes place restrictions on the use of the funds as well as on the amount of awards. Fellowships are awarded primarily to second- and third-year students on the basis of professional promise. Most fellowship recipients are directly involved in one of the academic programs of the school. These awards are nontaxable.

Assistantships fall into three categories: student, graduate, and research. They are obtained primarily from grant and contract funds awarded to various faculty of the school. In addition, University-funded assistantships are available. Assistantships are awarded to students who have sufficient experience to contribute to one or more ongoing research programs. Assistantships at lower levels of support are awarded to first-year students whereas higher levels of assistantship support are awarded to more experienced second-year students. The Ph.D. candidate can expect to obtain financial support almost exclusively from sources external to the University. Depending on the student's work assignment, assistantships may be taxable.

In all instances, admission to the school is a prerequisite for the award of any form of assistance for the first year of study. Renewal for the second year requires reapplication. Second-year awards are made on a competitive basis. The school is a participant in the Graduate and Professional Student Financial Aid Service (GAPSFAS). All scholarship and fellowship applicants must file application with GAPSFAS.

SCHOLARSHIPS

University Scholarships. A limited number of scholarships are awarded each year to selected students who are pursuing either professional or graduate degrees. Awards are made on the basis of academic qualifications and professional or scientific promise. Stipends range from \$500 to \$3,000 for the academic year.

FELLOWSHIPS

Georgia-Pacific Foundation Fellowship. Fellowships are awarded each year to selected students who are pursuing a master's degree in the Resource Operations Management Program. Stipends range up to \$2,000 per year.

Champion International Foundation Fellowship. Fellowships are awarded each year to selected students who are pursuing a master's degree in the Resource Operations Management Program. Stipends range up to \$2,000 per year.

Weyerhaeuser Foundation Fellowship. Fellowships are awarded to selected women and minority students interested in careers in industrial forestry. Students electing the Resource Operations Management Program are strong candidates. Several fellowships may be awarded each year at a level of \$6,000 per year.

Koppers Foundation Fellowship. Fellowships are awarded each year to students interested in the application of the management science to natural resource management. Stipends range up to \$2,000 per year.

AMAX Forest Products Fellowship. A fellowship is awarded each year to a student pursuing the master's degree in Resource Operations Management. The stipend is set at \$500.

Diamond International Fellowship. Fellowships are awarded each year to selected students who are pursuing a master's degree in the Resource Operations Management Program. Stipends range up to \$1,000 per year.

ASSISTANTSHIPS

Student Assistantships. Available to both professional and graduate students, these assistantships are particularly suited to the student who is interested in working only a few hours each week. Student assistants are employed to assist members of the faculty with their research and teaching, to assist members of the school staff, and to perform a variety of other functions such as gathering and assembling data on Duke Forest. A few student assistantships are available for independent research on various grants and contracts of the school. By the nature of their academic program, particularly of the master's project, some students are able to combine academic study with employment as a student assistant.

Student assistants are required to work either 250 hours or 500 hours during the academic year. Those employed for 250 hours can expect to work approximately 8 hours per week allowing for University vacation periods. Those employed for 500 hours of service can expect to work approximately 16 hours per week. Both levels of service require a regular schedule to be arranged between the student and the faculty member to whom he or she is assigned. Students who are employed at the higher level of service normally are limited to 10 units of course work per semester. Exceptions require the approval of the student's adviser and the dean. Only those students involved in research for their assistantship and those students involved in independent study or a master's project which is based on the research can expect to maintain an academic load in excess of 10 units.

Stipends for student assistantships requiring 250 hours of service range from \$800 to \$1,000 depending on the qualification and experience of the applicant. Student assistants employed for 500 hours may earn from \$1,600 to \$2,000. Depending on the nature of the work assignment, all or a part of the amount may be taxable.

A few student assistantships are available during the summer for research and teaching. Up to full-time employment of forty hours per week for a maximum of thirteen weeks is possible. Stipends range from \$1,500 to \$2,500, depending on qualifications and experience.

Graduate Assistantships. Awarded to students who are pursuing graduate degrees (A.M., M.S., Ph.D.), these assistantships require half-time service (1,000 hours) to the school during the calendar year. Graduate assistants have two options for fulfilling their service requirement: (1) twenty hours of work per week for the calendar year, or (2) sixteen hours per week for the academic year plus forty hours per week for thirteen weeks of the summer.

Typically, the graduate assistant is assigned to a member of the faculty to work on a particular research project under his or her direction and/or to provide teaching assistance. Furthermore, the research undertaken is normally a part of the student's graduate program and serves as a basis for the master's thesis or doctoral dissertation. With few exceptions, graduate assistantships are available only for the first two years of graduate study.

Graduate assistants are required to maintain a regular schedule of work as determined by the faculty member to whom each is assigned. Those accepting graduate assistantships will be limited to 10 units of course work per semester. Exceptions require the approval of the major professor and the dean.

Stipends for graduate assistants may range from \$4,000 to \$5,400 for a calendar year of service (1,000 hours). Normally, only a small part of the stipend is taxable.

Research Assistantships. Funded from grant and contract research under the direction of various members of the faculty, research assistantships provide support during the latter stages of study of the Ph.D. candidate. Typically, the research assistant completes one or more phases of a research project under the direction of the principal investigator, a member of the faculty. Normally, the research completed forms a substantial component of the requirements of the Ph.D. dissertation. However, in some instances this may not be the case and the students pursue dissertation research in a related area of study.

The level of service required of research assistants depends primarily on the nature of a particular research project and the availability of funds. Normally, research assistants are committed to either 500 hours or 650 hours of service during the academic year. The latter requires half-time service (20 hours per week). Almost all research assistantships require full-time service for thirteen weeks during the summer. A regular schedule of research under the direction of the principal investigator must be maintained and the academic load is limited to a maximum of 10 units per semester. The research assistant who is retained for half-time service during the academic year and full-time service during the summer may earn from \$4,000 to \$6,400. Usually only a small part of the award is taxable.

Application for Awards for the Entering Student. Application for awards may be made concurrently with the application for admission. Applicants should initiate the necessary action early to ensure that the required documents are filed with the dean of the school on or before 15 February prior to enrollment. Applicants should:

1. Complete the Graduate and Professional School Financial Aid Service (GAPSFAS) form, sent on request.
2. Furnish the following documents: *(a)* official transcripts of all previous college or university credits earned, *(b)* letters of reference from at least three persons familiar with the applicant's character, scholarship, and professional ability, and *(c)* scores from the aptitude test of the Graduate Record Examinations. Applicants should plan to take this examination in October at the latest. Documents offered in support of admission, if so designated, may also serve in support of the application for financial award.

Notification and Acceptance of Awards. Recipients of awards are notified in mid-March. Completed applications received after the 15 February deadline will be considered if vacancies occur at a later date.

Scholarships, fellowships, and the various categories of assistantships provide the basis for professional/graduate student support. Once offered by the University or the school, funds are committed to one student and are therefore unavailable to others. *As a consequence, it is the policy of the school that all awards offered can be declined prior to 1 April without prejudice. However, offers accepted and left in effect after 1 April are binding for both the student and the school.*

Loans

Applications for loans will be considered after admission and scholarship decisions have been completed. Approval of loan requests for monies administered by Duke University is based on financial need and satisfactory scholastic standing. Applicants for all loans administered or certified by Duke University are required



to file the form of the Graduate and Professional School Financial Aid Service (GAPSFAS). Information and application material for GAPSFAS can be obtained by writing to Educational Testing Service, Box 944, Princeton, New Jersey 08540.

Applications and complete details regarding the loan programs can be obtained by writing to the school. All applications for loans should be made before 1 July preceding the academic year in which the student plans to matriculate.

Federally Insured Student Loan Program. A graduate student may borrow up to \$5,000 per year to a maximum of \$15,000, including amounts borrowed during the student's undergraduate years. The interest rate is 7 percent, but the student may qualify for an interest subsidy while still in school through determination of need on the GAPSFAS report. Nine to twelve months after graduation or withdrawal from the University, interest and principal payments begin. The student has up to ten years for repayment. In order to be considered for a Federally Insured Student Loan (FISL), the FISL application should be completed.

National Direct Student Loan Program. Loans through the National Direct Student Loan Program (NDSL) are administered by the University. The funds are allocated to the University under strict federal guidelines on parental income, reasonableness of budget, complete disclosure of assets, and independent status of the student. The application for NDSL will be sent on request. GAPSFAS must also be submitted. Application may be made for up to \$2,500. Interest on these loans begins to accrue at 3 percent nine months after the student graduates or withdraws and repayment begins one month later with up to ten years to repay.

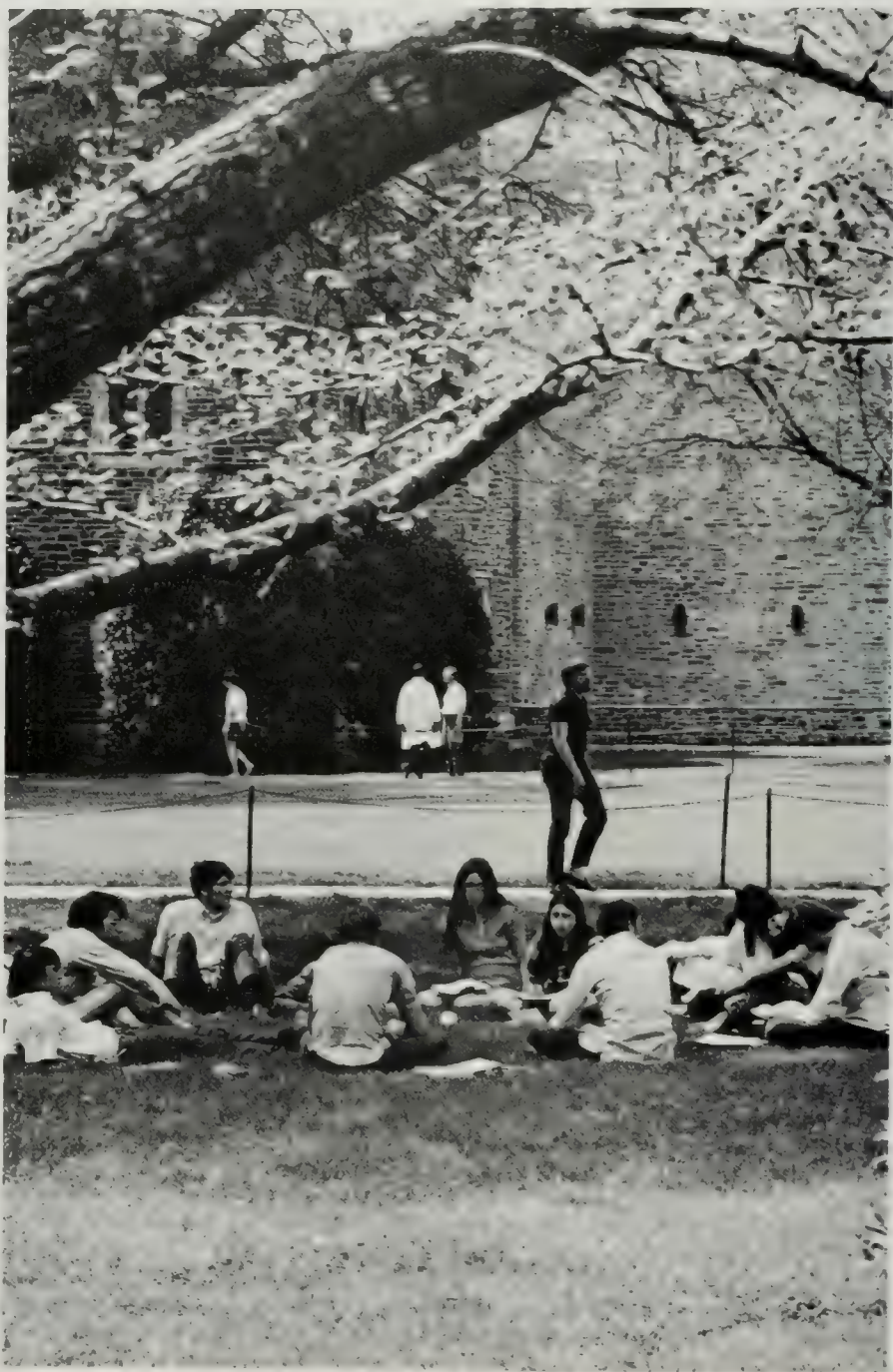


State Guaranteed Loans. Most states have established guaranteed loan programs for their own residents. The terms of such loans, the methods of administration, and the availability of funds vary widely among the states. The school will supply information regarding the appropriate agencies to contact in each state and will also make the appropriate certifications of individuals applying for state guaranteed loans.

Short-Term Loans. Short-term loans and emergency funds are available through the Champion Paper Foundation Fund, the E. S. Harrar Fund, the Forestry School Loan Fund, and the University's General Loan Fund. Each of these funding arrangements carries a 7 percent interest rate. Application for a loan is made at the dean's office. The funds are disbursed by the Student Loan Office on East Campus, which also arranges terms for repayment.

Work/Study. Work/study funds are administered for student employment through the dean's office as student assistantships. Students in the school are not eligible for work/study jobs administered through the University's placement office and are not awarded work/study funds in financial aid packages. Students who anticipate the need for a work/study position should complete the GAPS FAS form at the time they accept admission. Jobs are granted to those with established need and with the skill or training required by a professor for a particular type of teaching or research. It is the responsibility of the student to inquire about jobs with individual professors and with the dean of the school.

Student Life



Off-Campus Housing

Most of the students at the school join the annual scramble to find a place to live off campus. About one-sixth live in on-campus apartment complexes owned by the University and in the graduate residence halls.

The University is very much a part of the urban environment that is Durham, but the campus is not an urban one. It is not traversed by streets with housing and businesses. Consequently the perimeter of the West Campus is densely developed with apartment complexes, and the East Campus is adjacent to a neighborhood of large early twentieth-century homes, some of which have been converted to apartments. Free bus service is available between the two campuses.

In August and early September, the Department of Housing Management operates an off-campus housing service which consists of a staff person who maintains listings of apartment openings, house rentals, and "roommates wanted." The off-campus housing service does not rate the quality of apartments, houses, or landlords, nor arrange apartment viewings.

Apartments within walking or bicycling distance are in the range of \$165–\$230 for two bedrooms and \$180–\$290 for three bedrooms. Houses currently rented by students generally accommodate three or four persons at an average per person monthly rent of \$90 plus utilities. The demand for rentable houses far exceeds the supply. They are generally located at a distance from West Campus that requires a hardy cyclist or a person with a car.

University Housing

Graduate Residence Hall Accommodations. For the academic year 1979–80, a limited number of rooms for women will be available in Trent Drive Hall near the Duke Medical Center. Additionally, space for graduate and professional students will be available in the Durham Motor Inn, leased by Duke University. The motel is located in downtown Durham at the corner of Chapel Hill and Corcoran streets.

Trent Drive Hall also houses undergraduate men and women, Medical Center administrative offices and cafeteria. The three single rooms and eight double rooms which are reserved for graduate and professional women offer economical accommodations for those who desire to reside in a residence hall.

The Duke-leased Durham Motor Inn includes two floors of twenty-two rooms each. The lower level rooms open onto a large open deck. The upper level rooms open onto a walkway with steps leading to the open deck. Each room is

separately heated and air conditioned. The entire area under lease is well secured. Bus service to and from campus is provided during the academic year.

Information on graduate student housing is available from the Department of Housing Management during the spring semester.

Town House Apartments. Town House Apartments is a thirty-two-unit complex of two-bedroom apartments which is located between East and West campuses. Some of the apartments are furnished for occupancy by two single students and the remainder for three single students with two students sharing the large bedroom. Although intended for single students, married students and families may apply for these apartments. Town House Apartments have one and a half baths, a living room, and kitchen with dining area. Students must arrange for and pay for electricity, gas, and telephone. The complex is air conditioned and has a swimming pool, and is easily accessible to the campus bus line. These apartments are available for continuous occupancy, summer months included, if desired.

Central Campus Apartments. In 1974 the University opened a 500-unit complex, the Central Campus Apartments. Units are available for single and married students. For single students, fully furnished one-, two-, and three-bedroom units are available. Apartments for married students include a few furnished efficiencies and one-, two-, and three-bedroom unfurnished units or units in which the living room and first bedroom are furnished. An allocation plan is followed so that each segment of the student community is represented in the apartments. Because of this and an expected turnover of about 25 percent annually, not all applicants may be accommodated at the time they desire. These units are available for continuous occupancy, summer months included, if desired.



Modular Homes. The University owns six modular homes which are located between East and West campuses. They are reserved for single students. These three-bedroom homes are equipped for three-person occupancy and have proved to be popular. They are usually reserved by students who have occupied other University accommodations during the previous academic year. Students arrange for and pay for electricity and phone.

Application and Residential Deposit. Application forms, housing information, and regulations governing the occupancy of rooms and apartments will be mailed when the Graduate School or School of Forestry and Environmental Studies has notified the Department of Housing Management of official acceptance of the student.

A residential deposit of \$50 must accompany the application form but does not guarantee a space. This deposit is held throughout the term of the original occupancy and any subsequent renewal. In addition to the \$50 residential deposit, a student currently residing in University housing and desiring to reserve accommodations for the next academic year or a shorter period must make a \$50 prepayment of housing fees to the Office of the Bursar. The bursar's receipt must be presented to the Department of Housing Management at the time the application is made. This prepayment is refundable if a student withdraws from the University; has an approved leave of absence prior to 15 August and notifies the Department of Housing Management at that time; or cancels the application on or before 15 July.

Housing fees for single students are payable for an entire semester unless special arrangements to pay on a different basis are made with the University bursar. Married students may make monthly payments as required by the terms of the lease. Housing costs are listed in the Financial Information section.

Additional payments above the rates for the academic year are required for students who must arrive earlier than the dates established for occupancy or remain later than the dates established for vacating University housing.

Roommate matching is done by the Department of Housing Management on the basis of several questions on the application form. Appeals for changing roommates are accommodated at the conclusion of a semester.

Services for Students

Medical Care. The main components of the student health service include the University Health Services Clinic, located in the Pickens Building on West Campus, and the University Infirmary on the East Campus. Emergency transportation, if required, can be obtained from the Duke campus police. The facilities of the University Health Services Clinic are available during both regular and summer sessions to all full-time students. The facilities of the University Infirmary are available only from the opening of the University in the fall until graduation day in the spring to all currently enrolled full-time students.

To secure the benefits of the student health service, a graduate student, during the term or semester in which the illness occurs, must (1) in the summer session term be registered for at least 1 unit of research or 3 units of course work; (2) be registered for at least 9 units per semester. The costs of student health benefits have been borne by tuition in the past, but are now separate and can be identified as a medical expense for tax purposes. The student health fee is nonrefundable after the first day of classes. Students are not covered during vacations, and their dependents and members of their family are not covered at any time.

The resources of the Medical Center are available to all students and their spouses and children. Charges for all services received from the Medical Center are the responsibility of the student.



The Student Mental Health Service is located in the Old Chemistry Building, West Campus, and provides evaluations and brief counseling and/or treatment for matters ranging from questions about normal growth and development to the most serious psychiatric disorders.

The University has an Accident and Sickness Insurance Plan available for full-time students. Although participation in this plan is voluntary, the University expects all graduate students to be financially responsible for medical expenses above those covered by the student health service. Students who have medical insurance or wish to accept the financial responsibility for any medical expense may elect not to join the Accident and Sickness Insurance Plan by signing a statement to this effect. Each full-time student in residence must purchase this student health insurance or indicate the alternative arrangement.

The Student Accident and Sickness Insurance Plan provides protection twenty-four hours a day during the twelve-month term of the policy. Students are covered on and off the campus, at home, while traveling, and during interim vacation periods. For additional fees a student may obtain coverage for a spouse or spouse and children. Term of the policy is from opening day in the fall. Coverage and services are subject to change as deemed necessary by the University.

Office of Placement Services. The Office of Placement Services acts as a liaison between the University and potential employers. Students who wish to register with the office are offered an opportunity to assemble a dossier of academic records and recommendations in preparation for interviews and to have a permanent file for future reference. Interviews with representatives from industry and government are scheduled throughout the year for those students who have registered with the placement office. All services are offered without charge to students and alumni. In addition, the school maintains its own placement facilities. For further information, see the Placement section in this bulletin.

International Adviser. The International Office handles governmental matters for students from abroad such as statements of attendance for home governments, issuance of United States immigration forms for re-entry into the country after a temporary absence, and required yearly extensions of time. Any new student who is not a citizen of the United States should report with passport to the international adviser soon after arrival. The International Office is located on East Campus, 210-A East Duke.

Other Services. An information desk, art gallery, and game room are located in the Flowers Building. The University Store for school and office supplies and sundries, United States Post Office, barbershop and hairdresser, and bank are located in the Union. The Book Exchange, in downtown Durham, buys and sells second-hand and new textbooks. The Gothic Bookshop on campus sells quality fiction and nonfiction.

Student Organizations and Activities

Sports. Students are welcome to use such recreational facilities as the swimming pools, tennis courts, golf course, track, jogging course, handball and squash courts, gymnasias, weight room, and playing fields. Intramural programs provide an opportunity to participate in informal and competitive physical activity. A variety of clubs for gymnastics, scuba diving, sailing, cycling, badminton, karate, rugby, soccer, and crew are also active.

FOREM. The FOREM Club is the student organization for coordination of the school's social functions and intramural team participation. Annual functions of the club include a Christmas party, Christmas tree sale, Field Day, and year-end banquet.

Student Advisory Committee. The Student Advisory Committee, an elected student group, meets regularly with the dean and faculty representatives to offer advice on courses and curriculum, programs, and long-range goals of the school.

Professional and Scientific Societies. Students are encouraged to participate in one or more professional or learned societies appropriate to their academic interest. Most of these societies are highly interested in participation by students. Not infrequently a lower fee is established to encourage student membership. Some learned societies which might be considered for membership include American Association for the Advancement of Science, American Institute of Biological Sciences, American Economics Association, American Meteorological Society, American Phytopathological Society, American Society of Plant Physiologists, American Statistical Association, Ecological Society of America, and the Entomological Society of America. The Society of American Foresters, American Institute of Planners, the American Fisheries Society, and the Range Society are examples of typical professional societies which students might consider for membership.

Religious Services. Interdenominational services are conducted on Sunday mornings in Duke Chapel. Roman Catholic masses are offered daily on campus. Several Protestant denominations have student centers on campus. The Divinity School conducts other chapel services and religious and social activities. There is also a Hillel group which meets regularly.

Cultural Activities. Concerts, recitals, lectures, plays, films, and dance programs are presented frequently on campus. Information on major events is available at Page Box Office. The University Museum of Art, which has some excellent permanent collections, is located on East Campus.

Academic Regulations



Planning

The responsibility for the specific content of the academic plan of study rests with the student. A thorough familiarity with and understanding of the regulations contained in this bulletin as well as other sources provided by the school are essential to sound planning.

During the fall term each student is assigned a permanent faculty adviser. The adviser should be consulted in planning a course of study. Other members of the faculty, particularly those concerned with the plan of study, should also be consulted on an informal basis. Reassignment to another adviser can be obtained, but only by written request to the dean.

Registration

Students who register for the Master of Forestry or Master of Environmental Management degrees will receive instructions by mail a few weeks before the start of the August or September term. Registration for the August term is processed by the Office of the Summer Session of Duke University. Registration for later terms is processed through the School of Forestry and Environmental Studies. Registration should be completed and received by the appropriate office at least one week prior to the student's entrance.

Students in residence register for succeeding semesters at times scheduled in the University calendar.

Registration is approved by the adviser and processed by the recorder of the school and by the University bursar. Registration is required in order to take courses for credit or audit. To establish eligibility for University housing, for University loans and some outside loans, for the student health service, and for study and laboratory space, a student must be registered. All tuition and fee payments and any indebtedness must be settled before registration will be completed.

Late Registration. All students should register at the times specified by the University. The charge for late registration is \$25.

Change of Registration. With approval of the adviser, the student can change registration for a period of ten days following the close of registration. A change of fees requires completion of a new fee sheet which is obtained from the school recorder. *All changes of fees must be made on the first day of the ten-day change period.*

Refunds. Tuition refunds are governed by the policy stated in the chapter on Financial Information.

Graduate School Registration. Students in A.M., M.S., or Ph.D. degree programs register through the director of graduate studies of the Department of Forestry and Environmental Studies. Registration requirements and procedures are described in the section on graduate degrees of this bulletin and in the bulletin of the Graduate School.

Reciprocal Agreements. Students enrolled in the School of Forestry and Environmental Studies or in the Graduate School during the regular academic year, and paying full tuition and fees, may be admitted to a maximum of two courses per semester at the University of North Carolina in Chapel Hill, North Carolina State University in Raleigh, or North Carolina Central University in Durham. Similarly, graduate students in these schools may take up to two courses per semester at Duke.

Courses

Course Descriptions. Course descriptions are listed in the final section of this bulletin. Typical intensive courses offered in recent years are listed under Other Features. Both sets of offerings change from time to time as emphases change. A list of courses to be offered during a particular term is available from the recorder prior to registration for that term. Schedules of courses available in other departments at Duke and at neighboring universities are also available.

Independent Study. All students are expected to place increasing emphasis on independent study as they near completion of residence. FES 299 lists a number of independent project areas. Several students can work together under the supervision of a faculty member by registering for FES 202.

Master's Project. All students must complete a master's project of 4 to 8 credits. The project should be identified during the first term of study and initiated during the second term. During the final two terms major emphasis should be placed on the project. In completing the project, the student applies theoretical and analytical training acquired during the two years of study on actual natural resource or environmental problems. If desirable, arrangements can be made by the student or the school for consultation with other organizations concerning the scope and objectives of the project.

Students maintain close contact with their advisers during the development and writing of the master's project. Projects should reach final stages of completion by midterm of the final semester in residence. *All projects must be delivered to the adviser by 1 November for those graduating in December, by 1 April for those graduating in May, and by 1 August for those graduating in September.* The adviser is responsible for critical assessment and grading.

Auditing. A student who registers and pays fees for 12 units or more of course work may audit one course without charge. A fee of \$40 per course (subject to change) is charged for auditing more than one course or if the student is registered for less than 12 units. Written permission of the instructor prior to registration for the course is required. Audited courses must be so indicated on the registration card. In classes where enrollment is limited, students enrolled for credit will receive priority. Audited courses are recorded without grade on the student's permanent record card. Regular attendance is expected. Changes from audit to credit are not permitted after the drop/add period.

Dropping and Adding. The period for dropping and adding courses is limited to the first ten calendar days of the semester. Students are advised to make all class changes on the first day of class if at all possible. *Except under unusual circumstances, and with special permission of the dean, no reduction of tuition and fees is permitted unless classes are dropped on the first day of the drop/add period.*

For the special intensive courses, registration may be changed from one intensive course to another course of equal credit after the close of the drop/add period. However, there may be no change in the number of semester hours or in fees.

Retaking Courses. Courses required as a part of the program elected by the student or required by the adviser must be retaken if failed. Courses prerequisite to more advanced courses the student wishes to elect must be retaken if failed. Elective courses may be retaken if the student wishes to do so. Both the grade received when the course is retaken and the original failing grade will appear on the transcript.

Elective Courses. Each of the programs of study, whether one of those specified by the school or one designed by the student in consultation with the adviser, will include a number of elective courses. These courses may be selected from the offerings of the school or from other departments of the University. In addition, the student may consider elective courses in appropriate areas at the University of North Carolina in Chapel Hill, at North Carolina State University in Raleigh, and at North Carolina Central University in Durham.

Credit Hours

Students enrolled in the school are required to take at least 3 but no more than 15 units in a term. A full semester load is 15 units, which ordinarily consists of a combination of regular courses, independent projects, and the master's project for not more than 13 units, plus 2 units of seminars or modular courses. Not more than four regular courses can be taken in a semester. Permission of the dean is required to take less than 9 or more than 15 units in a semester.

Grades

The grading system used in the School of Forestry and Environmental Studies and the Graduate School is as follows: *E* (exceptional); *G* (good); *S* (satisfactory); *F* (failing); *I* (incomplete); *Z* (continuing).

The grade *P* (pass) is used in the School of Forestry and Environmental Studies for seminars, intensive courses, independent projects, modular courses, and master's projects. The grade of *Z* is assigned for a master's project or independent project which extends over a period of more than one semester. A final grade of *P* (pass) or *F* (fail) is given on completion of the project. Seminars, modular courses, and intensive courses are graded only on a pass/fail basis. Credit hours for courses completed on a pass/fail basis are creditable toward the master's degree.

A grade of *I* indicates that some portion of the student's work is lacking, for an acceptable reason, at the time grades are reported. Requirements of all courses in which a grade of Incomplete is assigned by an instructor must be fulfilled within one calendar year following the date of the assignment of the incomplete grade. If the student fails to complete the requirements within one calendar year, the *I* grade will be changed to a grade of *F*.

In exceptional circumstances, on the recommendation of the professor who assigned the grade of Incomplete and of the dean of the school, an extension of time for completion of the requirements may be granted. If, in the judgment of the

professor who assigned the grade of *I* and the dean, completion of the requirements is not a reasonable alternative for the student within the foreseeable future, permission may be granted to allow the grade of *I* to stand permanently on the student's record. Action to allow the *I* to stand permanently must be initiated *prior* to the time that a grade of *F* is recorded.

Academic Honors. A student who is registered for at least 9 units and who achieves a superior academic record consisting of all *Es* or at least equal credit hours of *E* and *G* will be named to the dean's honor list for that semester. Students who have achieved a superior academic record for all courses taken in residence may be eligible for graduation with honors or with highest honors. Faculty approval is necessary for graduation with honors. Factors considered in addition to academic achievement are professional promise, participation in student and academic extracurricular affairs, and the quality of the master's project.

Probation and Dismissal. Students are subject to dismissal from the school under any one or a combination of the following factors:

1. no grades higher than *S* during the first semester of study;
2. less than 6 units of *G* and/or *E* grades during the first full year of study;
3. a grade of *F* in any course at any time.

An appeal may be submitted through the adviser to the faculty to continue study under a probationary status. Probationary terms, set by the adviser, must be specific in the appeal and the appeal must be approved by the faculty. If probationary terms are met, the student will be returned to regular status. If probationary terms are not met, the student will be dismissed. Students will not be awarded degrees while on probationary status.

Academic Irregularities

All cases falling outside the regular policies and procedures of the school are referred to the Faculty Council for decision. The work of the council includes review and decision regarding course requirements for graduation, student probation and withdrawal, student petitions for waivers of degree requirements, and all actions which deviate from established academic regulations.

A student who desires to petition the council should do so in writing to the chairman. A precise statement of the reason for the request is required. The student will be notified in writing of the decision of the council by the chairman.

Transcripts of Credit

A student who is registered for a course and who successfully completes the requirements as prescribed by the instructor receives credit on the records of the school. Official transcripts of credit are issued only by the recorder of the school. Requests for transcripts, sent directly to the recorder, should state clearly the full name under which the work was taken, the dates of attendance, and to whom the transcripts are to be sent. The cost of a single transcript is \$2, payable in advance. Additional copies to the same address are 50¢ each. No transcripts will be issued for students who fail to clear all financial obligations to the University upon graduation.

Length of Study

For a full-time student entering without an undergraduate degree in forestry or environmental studies, the normal time for completing the master's degree is

four semesters plus the August term. No student, either full-time or part-time, is allowed more than five years to complete the requirements for the master's degree.

Application for the Degree

Even if degree plans are tentative, a candidate for a degree must file an application for the degree no later than the end of the sixth week of the semester in which the degree is to be received. For a degree to be awarded in September, application must be filed no later than the beginning of the second summer session. The application for the degree is valid only for the semester in which it is filed. If the student does not receive the degree as expected, he or she must file a new application.

All candidates are urged to attend the commencement exercises at which their degrees are to be awarded. A student who is unable to attend is required to file a petition with the dean, not later than four weeks prior to commencement, seeking permission to receive the degree in absentia.

Debts

Students who have borrowed funds from the school or the University to meet educational expenses are expected to settle all debts prior to completion of the degree. No records are released and no student is considered as a candidate for a degree until all debts are settled. Failure to pay all University charges on or before the times specified by the University will bar the student from class attendance until the account is settled in full.



Courses of Instruction



Resource Science

152. Conserving Natural Resources. Fundamentals of natural resource development, use, management, and protection based on principles of the natural and social sciences. Open only to undergraduates. 3 units. *Staff*

203. General Meteorology. A general introduction to the science of meteorology, particularly for students concerned with problems in biology and hydrology. Emphasis is placed on the fundamentals and role of the atmospheric thermodynamics and energy and mass transfer processes in determining both local and regional aspects of weather and climate. 3 units. *Knoerr*

204. Microclimatology. Introduction to the micrometeorological processes. Discussion of the integration of these processes and the resulting microclimates in the rural (forest, field, and water surface) and urban environments. Methods for modification of the microclimate. 3 units. *Knoerr*

206. Anatomy of Woody Plants. Primary and secondary structures in seedlings and in mature trees, shrubs, and vines. Techniques for gross observations and for study of micro- and ultrastructures with light and electron microscopy. Relationship of microstructures to growth patterns and characteristics. Comparative studies in relation to environmental adaptations and systematics. 4 units. *Philpott*

209. Tree Biology. Life processes and properties of trees, including anatomical, development, physiological, and chemical considerations. Emphasis on structure in relation to function in the tree and to uses of tree-derived products. 3 units. *Barnes.*

211. Resource Ecology and Ecosystem Analysis. An introduction to ecological principles with an emphasis on the ecosystem as a basic working unit. Perspectives include such topics as land/water interactions, the patchiness concept, succession, energy flow, productivity, mineral cycling, perturbation effects on ecosystems, microclimate, and limiting factors. Field studies will focus on the team approach to analyzing the biotic and abiotic components of the ecosystem and the effects of human use. 3 units. *Richardson*

212. Population Ecology. Discussion of population dynamics of natural and exploited populations. A quantitative approach with an emphasis on mathematical models and their application to population problems. 3 units. *Thompson*

216. Watershed Hydrology. Influence of vegetation, soil types, and land forms on water yield, water quality, and flood potential. Analysis of precipitation patterns, infiltration rates, erosion forces, and sediment carrying capacities of streams. Techniques and research methods used to control the hydrologic cycle, water quality, and water yield on wild lands. 2 units. *Hellmers*

217. Environmental Instrumentation. Consideration of physical bases for measuring parameters of natural and controlled environments. Properties and effective utilization of contemporary electronic measurement and data acquisition systems, including transducers, signal conditioners, and analog and digital recorders. Methods for obtaining and processing computer compatible records. Precision measurement and calibration techniques with primary and secondary laboratory standards. Three lectures and three laboratory hours per week. Prerequisite: consent of the instructor. Students should have a basic knowledge of the properties of environmental parameters and be able to write computer programs. 4 units. *Knoerr*

218. Barrier Island Ecology. Adaptation of plants to barrier island migration and other physical characteristics of the coastal environment. Major emphasis will be placed on management of barrier beaches from Maine to Texas and the impact of human interference with natural processes. Field studies. Prerequisite: course in general ecology. Offered at the Duke Marine Laboratory, Beaufort, North Carolina. 6 units. *Godfrey (visiting summer faculty)*

222. Biology of Forest Insects and Diseases. Fundamentals of entomology and plant pathology as applied to forest protection; coordinated laboratory work, with emphasis on identification and interpretation of forest and wood degradation. 4 units. *Anderson and Stambaugh*

223. Forest Pathology. Diseases of North American forests and their timbers, with emphasis on current literature and control strategies. Field and laboratory diagnosis. Prerequisite: 222 or consent of instructor. 3 units; 4-5 units with laboratory modules. *Stambaugh*

225. Chemical Aspects of Forest Protection. Chemical aspects of organisms attacking trees and of the materials used in their control. Emphasis on structures and properties in relation to functions and uses. Prerequisite: 222. 3 units. *Barnes*

230. Forest Entomology. Identification, biology, and control of insects that cause damage to trees and wood products. Emphasis of diagnosis is based on the characteristics of the damage and the stages of the insects responsible. Prerequisite: 222 or equivalent or consent of instructor. 4 units. *Anderson*

242. Silvics. The life histories and dendrological-utilization characteristics of major North American tree species, forest stands, and timber types, with particular reference to environmental factors. 2 units. *White*

264. Soil Classification and Interpretation. Soil characteristics and environmental factors related to soil formation and soil classification systems. Interpretation of soil properties and soil maps for determination of forest, rural, and urban fringe use capabilities and limitations. Effects of forest management practices on soil productivity. Laboratory includes field identification of soils and measurements of soil properties. 4 units. *Ralston*

291. Modules in Ecosystem Analysis. Introduction to methods of characterizing ecosystems, with special reference to identification, measurement, and mapping of vegetation, soil, water, and animal resources. Emphasis on field work. August session, hours to be arranged. 4 units. *Staff*

292. Microtechnique of Soft Woody Plant Tissues. Preparation of plant parts for microscopic study including sectioning, staining, and mounting techniques. Prerequisite: consent of instructor. Offered on sufficient demand. 3 units. *Philpott*

305. Forest Biochemistry. Biochemistry applied to structure and function of woody plants and associated fungi and insects. Prerequisites: courses in plant physiology and chemistry. 3 units. *Barnes*

321. Phytopathological Technique in Forestry. Fundamentals of phytopathology as applied to field and laboratory investigations of tree diseases and wood degradation; biological interpretation of host-pathogen-environment interaction is stressed in literature review, experimentation, and scientific writing. Prerequisite: consent of instructor. 4 units. *Stambaugh*

322. Microbiology of Forest Soils. Ecology of the microbial populations of forest soils, with emphasis on rhizosphere interactions, root pathogenesis, and mycorrhizae. Prerequisite: consent of instructor; mycology and bacteriology are recommended. 4 units. *Staff*

332. Ecology of Forest Insects. The influence of environmental factors on the vital processes of insects. Emphasis is on how both the abiotic and biotic elements influence the fluctuation of forest insect populations. Prerequisite: one course in entomology or zoology or consent of the instructor. 3 units; 4 units with laboratory. *Anderson*

342. Hydrologic Processes. Physical processes of the hydrologic cycle, with emphasis on those processes which can be modified or controlled by watershed management. Offered on sufficient demand. 3 units. *Knoerr*

350. Vegetation Productivity and Mineral Cycling in the Ecosystem. An ecosystem approach to studying the processes affecting productivity and mineral cycling in the world's biome. Emphasis on primary production, biomass accumulation, and biogeochemical cycling as affected by edaphic and climatic condition. Concepts of ecosystem analysis and research methodology are stressed. Prerequisite: consent of instructor; 264, 252, and a course in plant physiology are recommended. 3 units. *Richardson*

366. Forest Soil Fertility. Relationships of soil fertility factors to the growth of forest stands. Soil chemical properties and biological processes affecting mineral nutrition of trees. Soil amendment practices, including forest fertilization and land disposal of municipal wastes. Laboratory analysis of chemical composition of soil, water, and plant tissue samples. Prerequisite: 264. 4 units. *Ralston*

Measurements, Statistics, and Modeling

250. Biometry. Concepts and methods of statistics essential to the collection, analysis, and interpretation of resource and biological data. Emphasis is placed on problems of estimation, inference, and decision making with experimental data. 3 units. *Yandle*

251. Theory and Methods for Sampling Biological Populations. Introductions to statistical methods for sampling natural resources and biological populations. Simultaneous consideration is given to theoretical and experimental problems in the design and applications of sampling methods and in the interpretation of sample data. Prerequisite: 250 or consent of instructor. 3 units. *Yandle*

252. Natural Resource Data Analysis. Emphasis on problem analysis based on a working knowledge of statistical methods and the calculus. Review of

elementary concepts from statistics, including measure of central tendency, measures of dispersion, probability distributions, and common tests of statistical inference. Rules and applications of matrix algebra and the calculus to biological and natural resource problems. Major emphasis on concepts of data analysis, fitting and manipulation of functions using the calculus. 4 units. *Jayne*

253. Information Processing for Resource Management. Introduction to the organization of information storage and retrieval systems. Extensive use of Fortran (WATFIV) programming and a statistical package (SAS) in resource and environmental problem solving. 3 units. *Rajagopal*

258. Quantitative Analysis in Resource Management. Mathematical model formulation and analysis in resource and environmental decision making. Includes a survey of applications in linear programming, dynamic programming, CPM-PERT, inventory, statistical quality control, and simulation. Use of software codes in problem solving. 4 units. *Rajagopal*

289. Remote Sensing for Resource Management. An examination of remote sensing systems as sources of information in resource management with an emphasis on aerial photography and multispectral scanners. Emphasis will be placed on the interpretation of airborne and space imagery. 3 units. *Staff*

354. Biological and Resource System Simulation. Introduction to systems terminology. Differential and difference equations. Probabilistic concepts. Time and event simulations using problem-oriented software such as CSMP, DYNAMO, and GPSS. Applications in biological and resource sciences. Prerequisite: 252 or consent of the instructor. 3 units. *Rajagopal*

Natural Resource Management

210. Forest Utilization. Introduction to utilization in the managed forest and the principal wood-using industries. Taught as a one-week field seminar. May be taken by nonforestry majors. 1 unit. *Yandle*

244. Theory and Practice of Silviculture. Principles governing establishment, treatment, and control of forest stands; natural and artificial methods of reproduction, intermediate cuttings, and cultural operations, with emphasis on the principal forest types of temperate North America. Field practice in silvicultural operations and study of managed stands. Prerequisite: 211 or equivalent. 2 units; 3 units with laboratory. *White*

245. Management of Small Woodlands. Practical application of principles of forest management to small tracts. Field examinations, compilation of data, negotiations, and actions for landowners in diverse market and tax situations. 2 units. *Staff*

271. Financial Management. Analysis of the problems of management of the financial affairs of the firm: working capital, long-term capital needs, including the development of an optimal capital structure, with attention to tax problems. 3 units. *Joerg*

281. Forest Resource Management. Principles of organizing forest properties for systematic management; use of data obtained in surveys and inventories; principles of forest regulation, including a study of normal and actual forests, rotations, cutting cycles, and methods of regulating the cut in even-aged and all-aged forests for sustained yield; introduction to the preparation of preliminary forest management plans. 3 units. *Staff*

282. Natural Resource Management. Methodologies for analysis of problems in resource management and their application to several specific problems. Techniques of simulation modeling will be used to integrate knowledge, define problem focus, and facilitate communication across ecological, economic, demographic, social, and political dimensions. 3 units. *Thompson*

283. Fire Behavior and Use. Impact of destructive agencies upon forests; principles of combustion, fire behavior, danger measurement, and suppression; use of fire in forest management. 2 units. *White*

349. Wildland and Wildlife Management. The paradox of managed natural systems is considered in the context of plant, animal, and human population dynamics. Topics include vegetation management, wildlife management, and wilderness recreation management, including camping, backpacking, hunting, and fishing. Special attention is paid to wildland preserve and open space planning. 3 units. *Staff*

382. Legal Aspects of Forestry. A seminar on certain state and federal laws pertinent to the management of forests: land ownership, trespass, public liability, timber contracts, labor relations, and use of pesticides. 1 unit. *Staff*

Natural Resource Policy

269. Resource Economics and Policy. The application of economic concepts to private and public sector decision making concerning natural resources, especially renewable resources. Investment analysis, benefit-cost analysis. Planning and policy concepts. 3 units. *Convery*

270. Economics of Forestry. Economic concepts applied to private and public sector decision making concerning forest based resources. The role of economics in public forest land use planning. Benefit-cost analysis. Investment analysis and private forest lands. Alternate years. 3 units. *Convery*

272. Business Policy. An integrating course where, through analysis of case problems from the top management viewpoint, the student is given practice in arriving at effective courses of action for the solution of business problems. 3 units. *Joerg*

273. Economics and Environmental Quality. Consideration of the economic dimensions of the environmental problem. Exploration of the reasons for market failure; investigation of possible remedies, including a tax on residuals and direct control. Examination of the modifications required in cost-benefit and input-output analysis to incorporate environmental values. Discussion of economic growth, natural resource scarcity, and environmental quality. Prerequisite: consent of instructor. 3 units. *Convery*

Seminars

277. Seminar in Natural Resource Allocation and Efficiency. Evaluation of economic principles concerned with problems of natural resource allocation, with special attention to the alternatives for governmental policies in private property economics. Prerequisite: consent of instructor. Alternate years. 1 unit. *Convery*

344. Micrometeorology and Biometeorology Seminar. Advanced topics in the physics of the earth's surface environment, with emphasis on plant and animal microclimates; budgets of mass, momentum, and energy; vertical structure of wind, temperature, water vapor, and carbon dioxide in relation to exchange

processes within the biosphere. Prerequisite: 204 or equivalent and consent of instructor. Offered on sufficient demand. 2 units. *Knoerr*

346. Seminar in Resource and Environmental Policy. Discussion of the political, legal, and socioeconomic aspects of public and private action in environmental quality control and management. Prerequisites: 269 and consent of instructor. 1 unit. *Convery*

347. Seminar in Natural Resource Ecology. Discussion of current ecological and environmental problems and research topics related to the management of natural resources. Units to be arranged. *Staff*

348. Integrated Case Studies in Natural Resource Analysis Seminar. Examination and analysis of the integrated case study for solving resource and environmental problems. Units to be arranged. *Staff*

385. Seminar in Forest Protection. Current problems in forest and shade tree protection and research applications in entomology, pathology, and physiology as related to natural resource management. Prerequisite: consent of instructor. 1 unit. *Staff*

386. Seminar in Forest Resource Management. Examination and analysis of techniques employed in the management of industrial and public forests, particularly in the South; discussion of problems of large-scale intensive forest management. Prerequisites: 244 and 281 or equivalents. 1 unit. *Staff*

Special Studies and Projects

191, 192. Independent Study in Forestry and Environmental Studies. Directed reading and research. Open to qualified students in junior and senior years by consent of the student's department in Trinity College and of the School of Forestry and Environmental Studies. Units to be arranged. *Staff*

201. Field Studies. Visits to and studies of resource use and management areas and activities outside the University. Units to be arranged. *Staff*

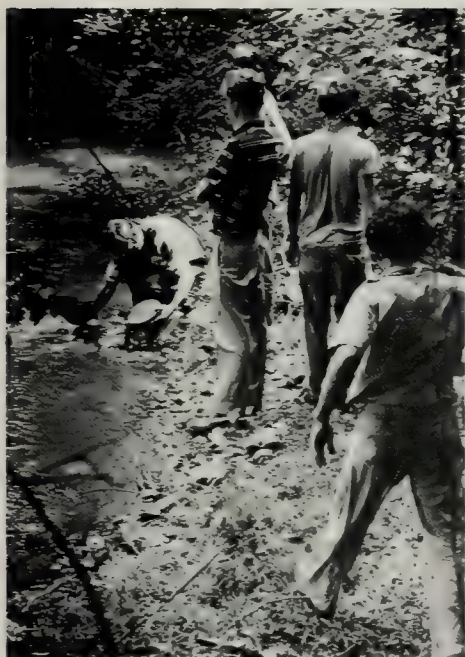
202. Student Projects. A group of five or more students may plan and conduct their own research project on a special topic, not normally covered by courses or seminars. A request to establish such a project should be addressed to the dean with an outline of the objectives and methods of study and a plan for presentation of the results to the school. The dean will designate the units to be earned and a faculty member for the evaluation and grading of the work of each participant.

299. Independent Projects. Directed readings, research, or practical work at the graduate level to meet the needs of individual students in the following areas. Units to be arranged. Undertaken with the guidance of the faculty member listed.

- 299.1 Dendrology. *White*
- 299.2 Ecology. *Richardson, Thompson*
- 299.3 Entomology. *Anderson*
- 299.4 Environmental Design. *Staff*
- 299.5 Environmental Education. *Rajagopal*
- 299.6 Environmental Policy and Values. *Convery*
- 299.7 Environmental Systems Analysis. *Staff*
- 299.8 Forest Management. *Staff*
- 299.9 Mensuration and Biometry. *Yandle*
- 299.10 Meteorology and Hydrology. *Knoerr*
- 299.11 Operations Research. *Rajagopal*
- 299.12 Pathology. *Stambaugh*
- 299.13 Physiology and Biochemistry. *Barnes, Hellmers*
- 299.14 Plant Anatomy. *Philpott*

- 299.15 Propagation of Woody Plants. *Philpott*
- 299.16 Resource Economics. *Convery*
- 299.17 Resource Planning. *Staff*
- 299.18 Resource Management. *Staff*
- 299.19 Silviculture. *White*
- 299.20 Soils. *Ralston*

399. Master's Project. An applied study of a forestry or environmental management problem or a theoretical research effort. A seminar presentation of the objectives, methodology, and preliminary findings is required. A written (or other medium) report at the conclusion of the project is also required. Units to be arranged. Undertaken with the guidance of the student's adviser.



Numerical Listing of Courses

- 152. Conserving Natural Resources
- 191, 192. Independent Study
- 201. Field Studies
- 202. Student Projects
- 203. General Meteorology
- 204. Microclimatology
- 206. Anatomy of Woody Plants
- 209. Tree Biology
- 210. Forest Utilization
- 211. Resource Ecology and Ecosystem Analysis
- 212. Population Ecology
- 216. Watershed Hydrology
- 217. Environmental Instrumentation
- 218. Barrier Island Ecology
- 222. Biology of Forest Insects and Diseases
- 223. Forest Pathology
- 225. Chemical Aspects of Forest Protection
- 230. Forest Entomology
- 242. Silvics
- 244. Theory and Practice of Silviculture
- 245. Management of Small Woodlands
- 250. Biometry
- 251. Theory and Methods for Sampling Biological Populations
- 252. Natural Resource Data Analysis
- 253. Information Processing for Resource Management
- 258. Quantitative Analysis in Resource Management
- 264. Soil Classification and Interpretation
- 269. Resource Economics and Policy
- 270. Economics of Forestry
- 271. Financial Management
- 272. Business Policy
- 273. Economics and Environmental Quality
- 277. Seminar in Natural Resource Allocation and Efficiency
- 281. Forest Resource Management
- 282. Natural Resource Management
- 283. Fire Behavior and Use
- 289. Remote Sensing for Resource Management
- 291. Modules in Ecosystem Analysis
- 292. Microtechnique of Soft Woody Plant Tissues
- 299. Independent Projects
- 305. Forest Biochemistry
- 321. Phytopathological Technique in Forestry
- 322. Microbiology of Forest Soils
- 332. Ecology of Forest Insects
- 342. Hydrologic Processes
- 344. Micrometeorology and Biometeorology Seminar
- 346. Seminar in Resource and Environmental Policy
- 347. Seminar in Natural Resource Ecology
- 348. Integrated Case Studies in Resource Analysis Seminar
- 349. Wildland and Wildlife Management
- 350. Vegetation Productivity and Mineral Cycling in the Ecosystem
- 354. Biological and Resource System Simulation
- 366. Forest Soil Fertility
- 382. Legal Aspects of Forestry
- 385. Seminar in Forest Protection
- 386. Seminar in Forest Resource Management
- 399. Master's Project

Appendix

Registered for the Master of Forestry Degree

- * Anderson, Patti Jean (B.S., Presbyterian College), Clarkesville, Georgia
- Bailey, Mark Blackburn (B.A., Miami University), Middletown, Ohio
- * Berger, Jose (B.A., Drew University), Caracas, Venezuela
- * Bonstedt, Stephen Mark (Miami University), Cincinnati, Ohio
- * Boyer, Chris Deborah (A.B., Franklin and Marshall College), Media, Pennsylvania
- Brown, Mary Jo (A.A., DeKalb College; B.S., Georgia State University), Atlanta, Georgia
- * Burgin, William Harris (B.S., Mercer University), Marietta, Georgia
- Carter, Allen Russell (B.S., University of Maine), North Hartland, Vermont
- Chaudhry, Yogendra (B.S., Meerut University), Subhash, Nagar, India
- * Conklin, David Allen (Duke University), Wilmington, Ohio
- Consoletti, William Louis (B.A., St. Francis College; M.A., Catholic University), Milford, Massachusetts
- * Davis, Grover Monroe, Jr. (Newberry College), North, South Carolina
- * DeWitt, Charles Millikan (University of the South), Nashville, Tennessee
- Dierking, Lynn Diane (B.S., University of Miami), St. Petersburg, Florida
- * Douds, David Donald, Jr. (B.S., Kent State University), Garfield Heights, Ohio
- * Exline, John Dwight (Lycoming College), Philadelphia, Pennsylvania
- * Foreman, John Michael (B.S., Albright College), Winchester, Virginia
- * Gerhardt, David William (B.S., Miami University), Cincinnati, Ohio
- Graupner, Christopher Toni (B.A., Tufts University), Newtown, Connecticut
- * Gunthorpe, Paul James (B.S.E., Duke University), North Palm Beach, Florida
- Haag, David Charles (B.S., Cook College, Rutgers University), Middletown, New Jersey
- * Harris, Carlton Matthaei, Jr. (B.A., Western Maryland College), Catonsville, Maryland
- * Hauenstein, Eric Bradford (Juniata College), Bellwood, Pennsylvania
- * Hawkins, Thomas Edward (B.S., Guilford College), Bethesda, Maryland
- * Ianniello, Steve Sal (Albright College), Pennsacken, New Jersey
- * Kanaskie, Alan Matthew (B.S., Lebanon Valley College), Trevorton, Pennsylvania
- * Kane, Susan Peters (B.A., Franklin and Marshall College), Tenafly, New Jersey
- * Krohn, Steven Alan (B.A., Duke University), New York, New York
- Lane, Sara Ennis (A.B., Ed.M., Smith College), Clearwater, Florida
- * Leach, Kenneth (High Point College), Edison, New Jersey
- Leonard, James Brian (B.S.F., University of New Hampshire), Northport, New York
- Lindenmuth, William Daniel (A.B., Kenyon College), Westport, Connecticut
- * Long, Richard Harvey (Elizabethtown College), Columbia, Pennsylvania
- * Lynch, Darryl Jadwick (Baker University), St. Louis, Missouri
- * McCulloch, William Ness (A.B., Albion College), Springfield, Ohio
- Mallette, James Robert (B.S., University of Florida), Fort Walton Beach, Florida
- * Martin, Donald Christian (Drew University), Warren, New Jersey
- Mullaney, Gary Edward (B.S., North Carolina State University), Lanham, Maryland
- Oduwaiye, Emmanuel Ayoad (Ing. grad., Fachhochschule, West Germany; Dip. For., University of Ibadan), Ibadan, Nigeria
- * Ohmann, Janet Lynn (Duke University), Ormond Beach, Florida
- * Panuska, Kerry Lynn (A.A., SUNY at Farmingdale; Marshall University), Lindenhurst, New York
- * Parra, Francisco Roman (Franklin and Marshall College), Hollywood, Florida
- * Pfistner, Stephen Frederick (B.A., Western Maryland College), Rockville, Maryland
- * Read, Catherine Deane (B.S., The College of William and Mary), Milwaukee, Wisconsin
- * Rupnik, Richard Robert (B.S., Moravian College), Bethlehem, Pennsylvania
- * Ruzsa, Peter Hubert (Miami University), Cincinnati, Ohio
- Schiff, Gary Franklin (B.A., University of Pittsburgh), Bethlehem, Pennsylvania
- * Schroeder, Robert Arthur (Drew University), Garden City, New York
- * Shindel, Thomas Edward (B.S., Franklin and Marshall College), Altoona, Pennsylvania
- * Stanley, Andrew Bassett (B.A., Duke University), Stanleytown, Virginia
- * Stout, Kevin Richard (Lycoming College), West Lawn, Pennsylvania
- * Stoyer, Karl Richard, Jr. (B.S., Albright College), Reading, Pennsylvania
- * Tauscher, Richard Wayne (B.A., Duke University), Louisville, Kentucky
- * Todd, Robert Powell (B.A., Duke University), Kinnelon, New Jersey
- van Alstyne, Robin Yolanda (A.B., Smith College), Petersham, Massachusetts
- Wais, William David (B.A., Xavier University), Cincinnati, Ohio

* Attended an undergraduate institution participating in the cooperative college plan

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 Yancey, William Frederick (B.A., Dartmouth College), Hanover, New Hampshire
 *Zinkhan, Frederick Christian (Franklin and Marshall College), Cockeysville, Maryland
 *Zoltowski, Joseph Walter (B.A., Lycoming College), King of Prussia, Pennsylvania

Registered for the Master of Environmental Management Degree

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 Bernick, Henry Clayton, III (B.P., University of Virginia), Virginia Beach, Virginia
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 *Bickle, Gary Lee (B.S., Juniata College), Tyrone, Pennsylvania
 *Bisesi, Phillip Salvatore (Wittenberg University), Rocky River, Ohio
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 Fuller, Brenner Kent (B.S., Stonehill College), Bellwood, Pennsylvania
 Goetzl, Alberto (B.A., Bates College), Washington, Maine
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 *Haring, David Marsland (B.S., Guilford College), Dawsonville, Georgia
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 Llewellyn, Michael (B.A., University of North Carolina), Durham, North Carolina
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Students in the Department of Forestry and Environmental Studies in the Graduate School

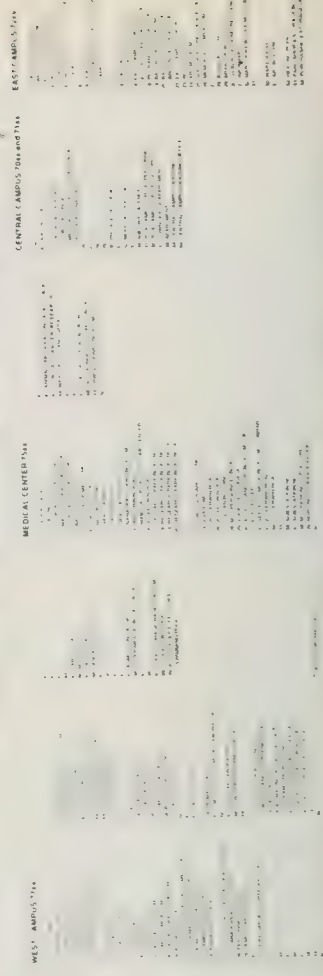
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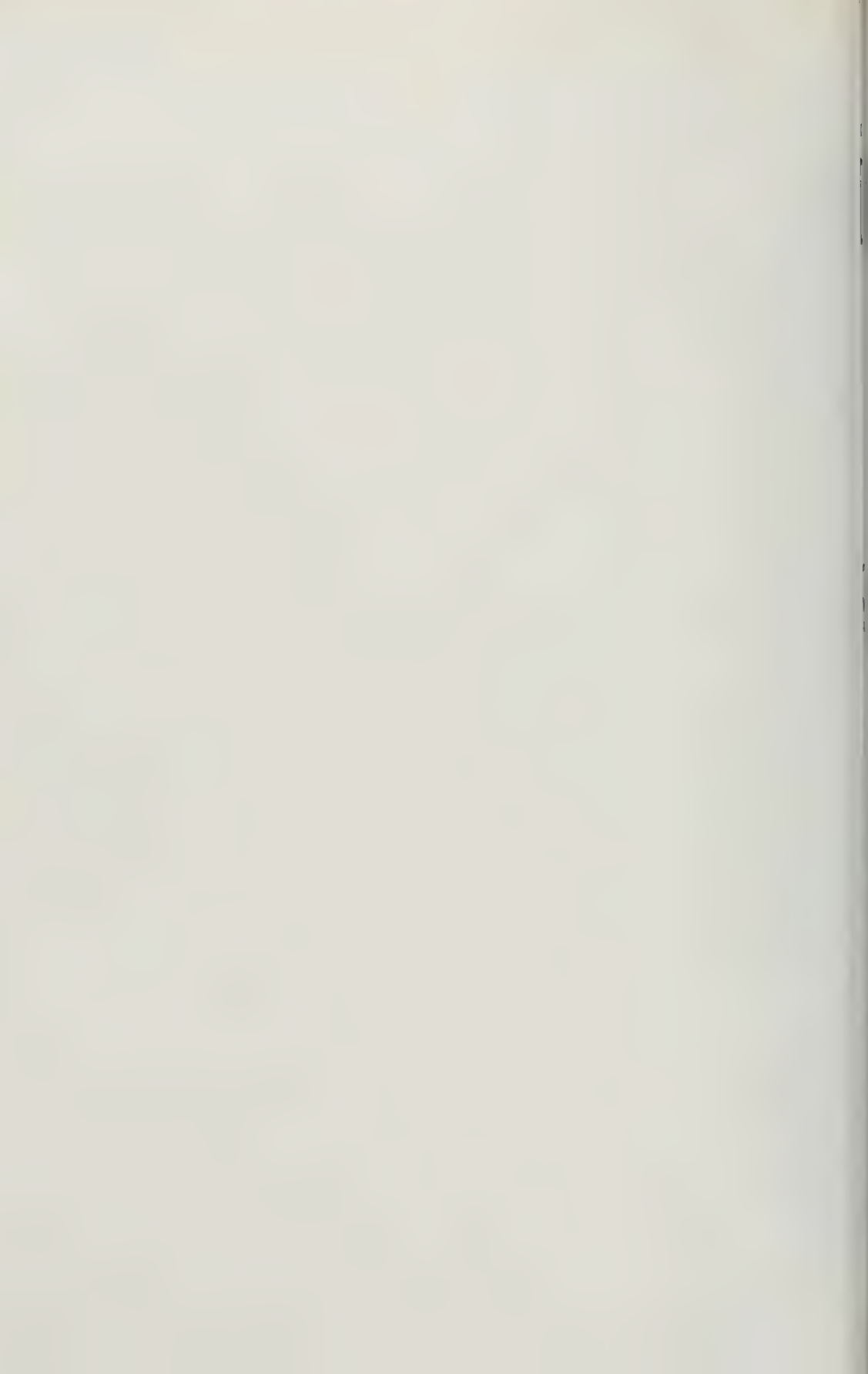
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Summer Educational
Programs

Term I: 8 May - 9 June

Term II: 11 June - 13 July

Term III: 16 July - 17 August



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COVER DESIGN
Donna S. Slade

Typesetting by Electronic Composition, Inc., Washington, D.C.
Printed by Greensboro Printing Company, Greensboro, N.C.

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Calendar of the Summer Session

1979

First Term: 8 May-9 June
Second Term: 11 June-13 July
Third Term: 16 July-17 August

March	
26-28	Preregistration of Duke students for summer and fall, 1979
May	
8	Tuesday—Summer session begins
June	
8	Friday—Term I exams begin Classes scheduled: Examinations are: 8:00-9:30 A.M. Friday, 8 June, 9:00 A.M.-12:00 noon 1:30-3:00 P.M. Friday, 8 June, 2:00-5:00 P.M. 9:50-11:20 A.M. Friday, 8 June, 7:00-10:00 P.M.
9	Saturday—Term I ends (Term I exams end) Class scheduled: Examination is: 11:40 A.M.-1:10 P.M. Saturday, 9 June, 9:00 A.M.-12:00 noon
11	Monday—Term II begins
July	
12	Thursday—Term II exams begin Classes scheduled: Examinations are: 8:00-9:30 A.M. Thursday, 12 July, 9:00 A.M.-12:00 noon 1:30-3:00 P.M. Thursday, 12 July, 2:00-5:00 P.M. 9:50-11:20 A.M. Thursday, 12 July, 7:00-10:00 P.M.
13	Friday—Term II ends (Term II exams end) Class scheduled: Examination is: 11:40 A.M.-1:10 P.M. Friday, 13 July, 9:00 A.M.-12:00 noon
16	Monday—Term III begins
August	
16	Thursday—Term III exams begin Classes scheduled: Examinations are: 8:00-9:30 A.M. Thursday, 16 August, 9:00 A.M.-12:00 noon 9:50-11:20 A.M. Thursday, 16 August, 2:00-5:00 P.M. 1:30-3:00 P.M. Thursday, 16 August, 7:00-10:00 P.M.
17	Friday—Term III ends (Term III exams end) Class scheduled: Examination is: 11:40 A.M.-1:10 P.M. Friday, 17 August, 9:00 A.M.-12:00 noon

Officers of the University Administration

Terry Sanford, J.D., LL.D., D.H., L.H.D., D.P.A., *President*
A. Kenneth Pye, LL.M., *Chancellor*
William Bevan, Ph.D., *Provost*
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John M. Fein, Ph.D., *Vice-Provost and Dean of Trinity College of Arts and Sciences*
Ewald W. Busse, M.D., Sc.D., *Associate Provost and Dean of Medical and Allied Health Education*
Roscoe R. Robinson, M.D., *Associate Vice-President for Health Affairs and Chief Executive Officer of Duke Hospital*
Frederick C. Joerg, M.B.A., *Assistant Provost for Academic Administration*
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William J. Griffith, A.B., *Assistant Provost and Dean of Student Affairs*
Clark R. Cahow, Ph.D., *Assistant Provost and University Registrar*
Caroline L. Lattimore, Ph.D., *Assistant Provost and Dean of Minority Affairs*
Richard L. Wells, Ph.D., *Assistant Provost and Associate Dean of Trinity College of Arts and Sciences*
Joel L. Fleishman, LL.M., *Vice-Chancellor for Public Policy Education and Research; Director of the Institute for Policy Sciences and Public Affairs*
Mel Ray, M.B.A., *Vice-Chancellor for Data Processing*
Connie R. Dunlap, A.M.L.S., *University Librarian*
William E. King, Ph.D., *University Archivist*
Robert N. Sawyer, Ed.D., *University Educational Planning Officer and Director of Summer Educational Programs*

Summer Educational Programs

Robert N. Sawyer, Ed.D., *University Educational Planning Officer and Director of Summer Educational Programs*
Calvin L. Ward, Ph.D., *Associate Director of the Summer Session*
Harold W. Lewis, Ph.D., *Vice-Provost and Dean of the Faculty*
John C. McKinney, Ph.D., *Vice-Provost and Dean of the Graduate School*
John M. Fein, Ph.D., *Vice-Provost and Dean of Trinity College of Arts and Sciences*
Ruby L. Wilson, R.N., Ed.D., *Dean of the School of Nursing*
Aleksander Vesić, D.Sc., *Dean of the School of Engineering*
Benjamin Jayne, Ph.D., *Dean of the School of Forestry and Environmental Studies*
Thomas F. Keller, Ph.D., *Dean of the Graduate School of Business Administration*
Thomas A. Langford, Ph.D., *Dean of the Divinity School*
Richard L. Wells, Ph.D., *Assistant Provost and Associate Dean of Trinity College of Arts and Sciences*
William J. Griffith, A.B., *Assistant Provost and Dean of Student Affairs*
Ella E. Shore, M.R.E., M.A., *Dean of Student Affairs of the School of Nursing*
Caroline L. Lattimore, Ph.D., *Assistant Provost and Dean of Minority Affairs*
Clark R. Cahow, Ph.D., *Assistant Provost and University Registrar*
Richard L. Cox, B.D., Th.M., *Associate Dean of Student Affairs*
James Douthat, B.D., Ed.D., *Associate Dean of Student Affairs*
Charles M. Harman, Ph.D., *Associate Dean of the Graduate School*
Charles R. Young, Ph.D., *Associate Dean of the Graduate School*
Marion L. Shepard, Ph.D., *Associate Dean of the School of Engineering*
Virginia S. Bryan, Ph.D., *Assistant Dean of Trinity College of Arts and Sciences*
Gerald L. Wilson, Ph.D., *Assistant Dean of Trinity College of Arts and Sciences*
Elizabeth S. Nathans, Ph.D., *Assistant Dean of Trinity College of Arts and Sciences*
Ellen W. Wittig, Ph.D., *Assistant Dean of Trinity College of Arts and Sciences*
Martina J. Bryant, Ed.D., *Assistant Dean of Trinity College of Arts and Sciences*
Paul B. Harrison, M.P.H., *Assistant Dean of Trinity College of Arts and Sciences and Adviser for Health Professions*
Robert Young, B.D., *Minister to the University*
John D. Costlow, Jr., Ph.D., *Director of the Duke Marine Laboratory*
Ella Fountain Pratt, A.B., *Director of the Office of Cultural Affairs*
Jean F. O'Barr, Ph.D., *Director of Continuing Education*
James Benjamin Smith, Jr., M.S.M., *Director of Chapel Music and Choral Music*
Jane Clark Moorman, M.S.W., *Director of Counseling and Psychological Services*

James Belvin, A.B., *Director of Undergraduate Financial Aid*
 Harry DeMik, M.Ed., *Associate Registrar*
 Lawrence W. Smith, Jr., B.A., *Director of Housing Management*
 Dorothy Brundage, R.N., M.N., *Acting Director of Academic Programs, School of Nursing*
 Joy Clausen, R.N., Ph.D., *Coordinator of Outreach Programs, School of Nursing*
 Annie Royal Watson, *Staff Assistant, Summer Session*

The Summer Session Faculty

Adams, Anne H., Ed.D., *Professor of Education*
 Alt, Arthur Tilo, Ph.D., *Associate Professor of Germanic Languages and Literature*
 Anderson, C. William, Ph.D., *Assistant Professor of Chemistry*
 Apte, Mahadev, Ph.D., *Associate Professor of Anthropology*
 Arges, Kiro Peter, M.S.C.E., *Assistant Professor of Civil Engineering*
 Artley, John, D.Eng., *Professor of Electrical Engineering*
 Ballantyne, Robert H., Ed.D., *Associate Professor of Education*
 Barber, Richard T., Ph.D., *Associate Professor of Zoology and Associate Professor of Botany*
 Bassett, Frank H., III, M.D., *Professor of Orthopaedics and Assistant Professor of Anatomy*
 Bessent, Helga W., M.A., *Assistant Professor of Germanic Languages and Literature*
 Bland, Kalman, Ph.D., *Associate Professor of Religion*
 Blumenfeld, Donald S., B.A., *Lecturer in Dance*
 Bolnick, Bruce R., Ph.D., *Assistant Professor of Economics*
 Bookhout, C. G., Ph.D., *Professor Emeritus of Zoology*
 Bordeaux, Janice, *Part-time Instructor in Psychology*
 Brown, Charlotte V., Ph.D., *Assistant Professor of Art*
 Bryan, Anne-Marie, M.A.T., *Assistant Professor of Romance Languages*
 Buckingham, Eugene, Ph.D., *Temporary Instructor in Psychology*
 Buehler, Albert G., M.A., *Professor of Physical Education*
 Burdick, Donald S., Ph.D., *Associate Professor of Mathematics and Associate Professor of Biomedical Engineering*
 Butts, Donald C., Ph.D., *Visiting Assistant Professor of History*
 Byrd, Nancy, M.A., *Part-time Instructor in Spanish*
 Carbone, Peter F., Jr., Ed.D., *Associate Professor of Education*
 Carson, Robert C., Ph.D., *Professor of Psychology and Professor of Medical Psychology in the Department of Psychiatry*
 Cartwright, William H., Ph.D., *Professor of Education*
 Caserta, Ernesto G., Ph.D., *Assistant Professor of Romance Languages*
 Cavaliere, Ralph, Ph.D., *Visiting Associate Professor of Botany*
 Chordas, Thomas J., M.A., *Part-time Instructor in Anthropology*
 Ciompi, Giorgio, M.A., *Artist-in-Residence in the Department of Music*
 Clum, John, Ph.D., *Associate Professor of English*
 Corless, Roger, Ph.D., *Associate Professor of Religion*
 Davis, Calvin D., Ph.D., *Professor of History*
 Davis, Lucy T., Ed.D., *Associate Professor of Education*
 DeNeef, A. Leigh, Ph.D., *Associate Professor of English*
 DiBona, Joseph, Ph.D., *Associate Professor of Education*
 Duffey, Bernard I., Ph.D., *Professor of English*
 Durden, Robert F., Ph.D., *Professor of History*
 Efrid, James M., Ph.D., *Associate Professor in the Divinity School*
 Eldridge, Albert F., Ph.D., *Associate Professor of Political Science*
 Elsevier, Ernest, M.S.M.E., *Associate Professor of Mechanical Engineering*
 Evans, Lawrence, Ph.D., *Associate Professor of Physics*
 Faksh, Mahmud A., Ph.D., *Visiting Assistant Professor of Political Science*
 Ferguson, Oliver W., Ph.D., *Professor of English*
 Fjeld, Jon, Ph.D., *Assistant Professor of Philosophy*
 Flowers, Anne, Ed.D., *Professor of Education*
 Forward, Richard B., Jr., *Associate Professor of Zoology*
 Fowlie, Wallace, Ph.D., *Professor Emeritus of Romance Languages*
 Friedrich, John A., Ph.D., *Professor of Physical Education*
 Garci-Gómez, Miguel, Ph.D., *Associate Professor of Romance Languages*
 Gehman, W. Scott, Jr., Ph.D., *Professor of Psychology in Education*
 Gifford, James F., Jr., Ph.D., *Associate Professor of Community and Family Medicine (Medical History)*
 Githens, Sherwood, Jr., Ph.D., *Professor Emeritus of Education*
 Glaeser, J. Douglas, Ph.D., *Adjunct Associate Professor of Geology*
 Godfrey, Paul, Ph.D., *Visiting Associate Professor of Botany*
 Grossman, David, M.A., *Part-time Instructor in Physical Education*

Gutknecht, John W., Ph.D., *Associate Professor of Physiology*
 Hall, Hugh M., Ph.D., *Professor of Political Science*
 Harvey, William J., M.Ed., *Associate Professor of Physical Education*
 Havrilesky, Thomas, Ph.D., *Associate Professor of Economics*
 Hellwig, Robert L., Ph.D., *Part-time Instructor in Botany*
 Henry, James D., M.M., *Assistant Professor of Music*
 Heron, S. Duncan, Jr., Ph.D., *Professor of Geology*
 Hodel, Richard Earl, Ph.D., *Associate Professor of Mathematics*
 Hollyday, Frederic B. M., Ph.D., *Professor of History*
 Hull, Alexander, Ph.D., *Associate Professor of Romance Languages*
 Jackson, Wallace, Ph.D., *Associate Professor of English*
 Jackson, Walter, *Visiting Instructor in History*
 Johnson, Terry W., Jr., Ph.D., *Professor of Botany*
 Jones, Barney L., Ph.D., *Professor of Religion*
 Jones, Buford, Ph.D., *Associate Professor of English*
 Jones, Yvonne V., Ph.D., *Visiting Assistant Professor of Anthropology*
 Kerr, Robert B., Ph.D., *Professor of Electrical Engineering*
 Kimble, Gregory A., Ph.D., *Professor of Psychology*
 Kinkead, Duncan T., Ph.D., *Assistant Professor of Art*
 Klages, Gunter, Ph.D., *Visiting Assistant Professor of Germanic Languages and Literature*
 Kolena, John, Ph.D., *Visiting Assistant Professor of Physics*
 Kornberg, Allen, Ph.D., *Professor of Political Science*
 Kruzel, Joseph J., Ph.D., *Assistant Professor of Political Science*
 Kuhn, David J., Ph.D., *Associate Professor of Education*
 Lakin, Martin, Ph.D., *Professor of Psychology*
 Lawrence, Bruce B., Ph.D., *Associate Professor of Religion*
 Leach, Richard H., Ph.D., *Professor of Political Science*
 LeBar, John A., Ed.D., *Associate Professor of Physical Education*
 Lehman, H. Eugene, Ph.D., *Visiting Professor of Zoology*
 Leiby, Robert W., *Visiting Assistant Professor of Chemistry*
 Lerner, Warren, Ph.D., *Professor of History*
 Lockhead, Gregory, Ph.D., *Professor of Psychology*
 Ludt, Robert L., Ph.D., *Visiting Associate Professor of Chemistry*
 Martin, David V., Ed.D., *Associate Professor of Education*
 Mauskopf, Seymour, Ph.D., *Associate Professor of History*
 McClay, David R., Ph.D., *Associate Professor of Zoology*
 McCollough, Thomas E., Th.D., *Associate Professor of Religion*
 Michlin, Michael L., Ph.D., *Assistant Professor of Education*
 Miller, Sara Elizabeth, Ph.D., *Assistant Medical Research Professor of Microbiology*
 Mitchell, Thomas G., Ph.D., *Assistant Professor of Mycology*
 Monsman, Gerald C., Ph.D., *Associate Professor of English*
 Myers, Roderick W., M.A., *Part-time Instructor in Physical Education*
 Nathans, Sydney, Ph.D., *Associate Professor of History*
 Newton, Fred B., Ph.D., *Counseling and Psychological Services Staff Psychologist and Adjunct Associate Professor in the Department of Education*
 Nowakowski, Richard, Ph.D., *Visiting Instructor in Psychology*
 Nygard, Holger O., Ph.D., *Professor of English*
 Oates, John F., Ph.D., *Professor of Classical Studies*
 Osborn, Robert, Ph.D., *Professor of Religion*
 Palmer, Richard G., Ph.D., *Assistant Professor of Physics*
 Partin, Harry B., Ph.D., *Associate Professor of Religion*
 Patrick, Merrell L., Ph.D., *Professor of Computer Science*
 Pearsall, George W., Sc.D., *Professor of Materials Science*
 Perry, Francis, M.A., *Visiting Instructor in Music*
 Pilkey, Orrin, H., Jr., Ph.D., *Professor of Geology*
 Pinkerton, Rolfs S., Ph.D., *Counseling and Psychological Services Staff Psychologist and Adjunct Associate Professor in the Department of Education*
 Pittillo, Robert A., Jr., Ed.D., *Associate Professor of Education*
 Pratt, Vernon, M.F.A., *Assistant Professor of Art*
 Preiss, Jack J., Ph.D., *Professor of Sociology*
 Price, James L., Ph.D., *Professor of Religion*
 Ramus, Joseph, Ph.D., *Assistant Professor of Botany*
 Reardon, Kenneth, M.A., *Associate Professor of English*
 Rice, Willy Earl, Ph.D., *Assistant Professor of Sociology*
 Riebel, John D., M.A., *Associate Professor of Physical Education*
 Regier, Ronald, *Technical Director and Lecturer in Drama*

Roberts, George W., Ph.D., *Associate Professor of Philosophy*
 Robinson, Hugh G., Ph.D., *Professor of Physics*
 Ross, David J., Ph.D., *Assistant Professor of Philosophy*
 Rosendahl, Bruce R., Ph.D., *Assistant Professor of Geology*
 Sanford, David H., Ph.D., *Professor of Philosophy*
 Schwartz, Michael, B.A., *Instructor of English*
 Searles, Richard B., Ph.D., *Associate Professor of Botany*
 Seed, Raymond, Ph.D., *Visiting Lecturer in Zoology*
 Shepard, Marion L., Ph.D., *Associate Professor of Materials Science*
 Simpson, Ida H., Ph.D., *Associate Professor of Sociology*
 Skinner, Leroy C., M.A., *Associate Professor of Physical Education*
 Smith, Grover C., Ph.D., *Professor of English*
 Smith, Harmon L., Ph.D., *Professor in the Divinity School and Professor of Community and Family Medicine*
 Smith, Joel, Ph.D., *Professor of Sociology*
 Smith, Peter, Ph.D., *Professor of Chemistry*
 Soufas, C. Christopher, M.A., *Instructor in Romance Languages*
 Spragens, Thomas A., Ph.D., *Associate Professor of Political Science*
 Stone, Donald E., Ph.D., *Professor of Botany*
 Strandberg, Victor H., Ph.D., *Associate Professor of English*
 Sullivan, James B., III, Ph.D., *Associate Professor of Biochemistry*
 Sutherland, John P., Ph.D., *Associate Professor of Zoology*
 TePaske, John, Ph.D., *Professor of History*
 Utku, Senol, Sc.D., *Professor of Civil Engineering*
 Wachtel, Howard I., Ph.D., *Assistant Professor of Biomedical Engineering*
 Warner, Seth L., Ph.D., *Professor of Mathematics*
 Weintraub, E. Roy, Ph.D., *Professor of Economics*
 Weisfeld, Morris, Ph.D., *Professor of Mathematics*
 Welsh, Paul, Ph.D., *Professor of Philosophy*
 White, Eleanor M., M.S., *Assistant Professor of Nursing and Assistant Professor of Psychiatric Nursing in the Department of Psychiatry*
 Wilbur, Robert L., Ph.D., *Professor of Botany*
 Wilder, Pelham, Ph.D., *Professor of Chemistry*
 Williams, Kenny J., Ph.D., *Professor of English*
 Wilson, John, Ph.D., *Associate Professor of Sociology*
 Withers, Loren R., M.S., *Professor of Music*
 Wright, Donald, Ph.D., *Associate Professor of Mechanical Engineering*
 Yohe, William P., Ph.D., *Professor of Economics*
 Zipp, John F., Ph.D., *Temporary Instructor in Sociology*



Program Information



Summer Study at Duke

The summer session at Duke University makes available a notable program of instruction in many fields, both academic and professional, to Duke students, to students from other universities and colleges, and to other special students. Although the summer course program is designed to meet the needs of degree candidates in many departments, it goes beyond these limits in also presenting courses of wide general interest and, in addition, special noncredit lectures, conferences, institutes, and workshops.

Undergraduate Study

Students in the undergraduate college and schools of Duke University who desire to enrich or accelerate their academic study will find summer programs to meet their individual needs and interests. Special courses and programs are provided which are not otherwise available to undergraduates. In addition, the summer session provides an excellent opportunity for Duke students to become involved in independent study. Summer programs enable some students to attain provisional graduate status in the senior year. Students who plan to attend professional schools will find the special programs and courses offered during the summer sessions advantageous.

Specific requirements for degrees offered in the undergraduate colleges and schools may be obtained from the *Bulletin of Undergraduate Instruction*.

Graduate Study

Degrees and Requirements. The Graduate School of Duke University now offers the following degrees: Master of Arts (A.M.), Master of Science (M.S.), Master of Education (M.Ed.), Master of Arts in Teaching (M.A.T.), Master of Health Administration (M.H.A.), Doctor of Education (Ed.D.), and Doctor of Philosophy (Ph.D.). Specific requirements relative to admission, residence, major and related studies, languages, and thesis requirements may be obtained from the *Bulletin of the Graduate School*.

Unclassified Graduate Students. Any student who holds an A.B. or B.S. degree and who does not intend to earn an advanced degree at Duke University but who desires graduate work for professional or other reasons should apply to the director of the summer session for admission as an unclassified student.

Credits earned by an unclassified student in graduate courses taken at Duke before admission to the Graduate School may be carried over into a graduate degree program if (1) the action is recommended by the student's director of graduate studies and approved by the dean, (2) the work is not more than two years old, (3) the amount of such credit does not exceed 6 units, and (4) the work is of G level or better.

Divinity School Study

Master of Divinity, Master of Theology, and Master of Religious Education degrees are administered by the faculty of the Divinity School. Students in these programs may register with the summer session office for independent study in any one of the terms of the summer session or for the language courses which are listed under the heading Divinity School in this bulletin. Persons desiring credit toward one of these degrees must be formally admitted to the Divinity School and all courses taken by the student for Divinity School credit must be registered and approved by the Associate Dean for Curricular Affairs in the Divinity School.

Forestry and Environmental Studies

The professional degrees of Master of Forestry and Master of Environmental Management are administered by the School of Forestry and Environmental Studies. Combined undergraduate-professional programs are available for eligible students. Master of Arts (A.M.), Master of Science (M.S.), and Doctor of Philosophy (Ph.D.) degree programs are also offered; these are administered by the Graduate School. Requirements for admission and degrees may be found in the *Bulletin of the School of Forestry and Environmental Studies*.

Graduate School of Business Administration Study

The Graduate School of Business Administration offers a Master of Business Administration (M.B.A.) degree and an Executive Master of Business Administration (M.B.A.) degree. Combined undergraduate-professional programs are available for eligible students. Specific requirements for degrees and admission may be obtained from the *Bulletin of the Graduate School of Business Administration*.

School of Nursing

Selected nursing electives and independent study (on or off campus) are available to undergraduate students already enrolled in the School of Nursing. Nursing students may pursue these or other courses to meet requirements of a second major, enrich or accelerate academic study, or complete required courses for upper division qualification. Summer session tuition rates apply.

For graduate students the three summer sessions are perceived both as the equivalent of one academic semester for the offering of required courses and as separate sessions for elective courses, which may extend for either one, two, or three sessions. The same academic policies for tuition rates of the School of Nursing graduate program apply for summer sessions as for the fall and spring semesters. Candidates for the M.S.N. degree who desire to have their degree conferred on 1 September must have completed all requirements for the degree as of the final day of the Duke University summer session.

School of Engineering

Selected engineering courses and independent study within each of the departments of the School of Engineering are available to all qualified undergraduate students. Engineering students may enroll in these or other courses to accelerate academic study, or to meet continuation requirements as stated in the *Bulletin of Undergraduate Instruction*.

Postdoctoral Research

Scholars engaged in postdoctoral research often find it advantageous to use the resources of Duke University during the summer. The University welcomes these visitors and makes living accommodations (dormitory space and dining facilities) available to them during the summer sessions from 8 May to 17 August 1979. Persons desiring research privileges (library and/or laboratory) should request approval through the department in which the research interests lie or through the Graduate School.

Special Programs

PATHS TO THE MODERN SOUTH

The history and culture of the South since Appomattox are explored in this two-course program (Term I), designed for undergraduates. The program will use this region, its people, and its resources as a living laboratory for the firsthand study of the South. The first course, History 165 (also IDC 165) examines four dimensions of the southern experience: art and architecture; kinship and family patterns; industrialization and the community; and images of the South. This course will be taught by Charlotte Brown of the Department of Art (Duke), Yvonne Jones of the Department of Anthropology (University of Louisville), Sydney Nathans of the Department of History (Duke), and Walter Jackson of the Department of History (Harvard). The second course, which will be taken concurrently with the first, consists of a seminar in one of the four subject areas. Each seminar will present the opportunity for discussion and fieldwork, on-site study, or archival research. For their second course in the program, students will choose either Art 191.2 (Southern Art and Architecture), Anthropology 193.25 (Culture and Kinship in the South), History 101S (Class and Community in a New South City), or History 101V (Visions of the South), taught respectively by Brown, Jones, Nathans, and Jackson. So far as possible, preferences will be followed in seminar assignments. Guest lecturers and discussions will be presented.

It is planned that this program on the South will be a living/learning experience with all students residing in Warwick House; a faculty member will be in residence.

For further information see the appropriate course listings and contact Dr. Sydney Nathans, Department of History, Duke University, Durham, North Carolina 27706.

ETHICS AND THE PROFESSIONS

This summer program, designed for preprofessional students and others interested in the ethical problems of the professions in society, consists of two courses to be taken concurrently during the first term. The first course, Religion 166, (also listed as Philosophy 166) is a series of lectures on moral traditions, ethical theories, professional ethics, and the professions in society; lectures will be given by Dr. Thomas E. McCollough of the Department of Religion, Dr. George W.

Roberts of the Department of Philosophy, Dr. Harmon L. Smith, Jr., of the Divinity School and the School of Medicine, and Dr. George W. Pearsall of the School of Engineering. The second course, Philosophy 167S (also listed as Religion 167S) consists of discussion classes on business ethics, legal ethics, medical ethics, and technological ethics, to be taught by Drs. McCollough, Roberts, Smith, and Pearsall. Guest lectures and discussions will be presented by members of the Duke business, law, medical, and engineering school faculties and by practicing members of these professions.

For further information see the course listings in philosophy and religion and contact Dr. Thomas E. McCollough, Department of Religion, Duke University, Durham, North Carolina 27706.

PRECOLLEGE PROGRAM

During the summer of 1979 Duke University will offer a five-week program from 9 June to 13 July for rising high school seniors from across the country. The Precollege Program is designed to provide the academic challenge of college-level courses to qualified college-bound students and to help prepare them for the adjustments they will be making when they enter college as freshmen. Introductory-level courses in the humanities, social sciences, natural sciences, and engineering will be offered for credit and there will be a wide range of campus programs and activities available as well. The students will live in supervised, air-conditioned University dormitories, eat their meals in the University dining halls, enjoy the opportunity of studying with distinguished members of the Duke faculty, and will have access to all University libraries, computing facilities, and athletic facilities. Special programs organized by the residential staff will include sessions on such topics as research and study skills, self-identity and interpersonal relationship problem-solving, health and physical fitness, and selection of careers and colleges.

For further information contact Dr. Robert Sawyer, Summer Educational Programs, Duke University, Durham, North Carolina 27706.

HEALTH CAREERS VOLUNTEERS

The summer Health Careers Volunteer Program is designed to provide hospital experience for summer school students who are considering careers in the health professions. Three of the local hospitals accept volunteers in wards, clinics, emergency rooms, and both clinical and research laboratories. Students will work three-hour shifts during the day, evening, or weekend for up to fifteen hours a week. The hospital experience is offered for any session in which a student is registered in summer school, with the exception of emergency room work. Emergency room work requires that students have transportation and that they be registered for two consecutive sessions of summer school.

Applications should be returned to: H.C.V. Program, Health Professions Office, 116 Allen Building. Applications for the first session must be returned by 6 May. Applications for the second and third terms must be received by 10 June.

Interinstitutional Agreement, Duke-U.N.C.

The long-standing reciprocal agreement between Duke and the University of North Carolina is effective for the summer sessions at both universities. To take advantage of this arrangement for either term of the summer session, the student registers each term for 3 units of credit at the home institution and 3 units representing the course to be taken at the other institution, for a total of 6 units. Credit so earned is not defined as transfer credit. This program applies to both

graduate and undergraduate students. Under this plan, courses may be taken only at the main campuses of the cooperating universities.

Duke University Marine Laboratory

The Duke University Marine Laboratory (DUML) is located at Beaufort, North Carolina, on Pivers Island, with direct access to open ocean, numerous bars and shoals, maritime marshlands, and various tributaries. Offerings include a full undergraduate spring term, an international training program, a cooperative undergraduate teaching program with thirteen participating universities, and three terms of summer school for graduates and undergraduates. Participating departments include zoology, botany, geology, chemistry, biochemistry, and physiology.

For information concerning application and registration, write to the Admissions Office, Duke University Marine Laboratory, Beaufort, North Carolina 28516.

Highlands Biological Station

Duke University holds a subscribing instructional membership in the Highlands Biological Station at Highlands, North Carolina, on the southern edge of the Blue Ridge Mountains at an elevation of 4,118 feet. The situation and the region offer an excellent opportunity for field studies and some laboratory work. A limited number of qualified students in botany and zoology may make arrangements to carry out research at this station.

For further information contact Dr. J. R. Bailey, Department of Zoology, Duke University, Durham, North Carolina 27706.

Organization for Tropical Studies

Duke University is a member of an international consortium created to promote an understanding of tropical environments and how to use them intelligently. To achieve these objectives, the Organization for Tropical Studies (OTS) fosters research and research training programs in the New World tropics. Fellowship applications are available from the Graduate School for travel and subsistence in field-oriented programs conducted primarily in Costa Rica. The basic OTS course, Tropical Biology: An Ecological Approach (8 units), runs for an eight-week period in January-February or in July-August. Advanced offerings are scheduled periodically in agriculture, anthropology, botany, earth sciences, forestry, geography, marine biology, meteorology, and zoology.

For further information contact Dr. Donald Stone, Department of Botany, Duke University, Durham, North Carolina 27706.

Teacher Education

Cooperative Program in Teacher Education. Selected graduates of liberal arts colleges who desire to prepare for high school teaching will be admitted to a special internship program at Duke University. This program is designed for selected college graduates who did not prepare professionally for teacher certification as undergraduates. The cooperative program provides graduate study for selected candidates in their special fields as well as professional courses and carefully supervised observation and teaching experiences. One who completes the program successfully can achieve within a period of fifteen months, a year of teaching experience, a Master of Arts in Teaching degree, and full certification as a teacher.

Candidates will begin the program at the opening of Term II of the 1979 summer session and complete it in August 1980. They will spend two terms of the summer preceding and the summer following the year of teaching in residence at the University. During the school year 1979-80 interns will be employed as regular teachers in cooperating public and private school systems. During this year they will receive full salary and will work under the joint supervision of the cooperating school and the University. The program will meet training qualifications for the advanced or graduate teacher's certificate in many states. Participants in the program are encouraged to teach for a second year as fully certified teachers in the school in which they complete the internship.

The salary for the year of teaching will, in effect, constitute a substantial award to candidates selected for the program. Applicants will be considered, as are candidates for other awards, on a competitive basis. The best qualified applicants will be chosen on the basis of undergraduate record, recommendations, and evidence of interest in becoming high school teachers. It is suggested that applicants arrange interviews in connection with their applications. Application forms and details concerning the program can be obtained by writing Dr. William Cartwright, Director, Cooperative Program in Teacher Education, Department of Education, West Duke Building, Duke University, Durham, North Carolina 27708. Application forms should be submitted before 1 March 1979.

Special Programs for Teachers of Science and Mathematics. It is anticipated that the summer session will again offer special programs at the graduate level designed specifically for secondary school teachers of science and mathematics. For detailed information on the programs, teachers should write Dr. Pelham Wilder, Jr., Department of Chemistry, Duke University, Durham, North Carolina 27706.

Foreign Study

Mexico. The Department of Religion will sponsor a Summer Program in Mexico (Mexico City and Cuernavaca) during Term II of the summer session. The five-week program, under the direction of Dr. Robert Osborn, will consist of two courses investigating liberation movements and the response of the church in Latin America. Extensive use will be made of local resource persons and field experiences and tours will bring students into contact with grassroots movements as well as to archaeological and cultural sites of general interest.

For further information see the course listings in religion and contact Dr. Robert T. Osborn, Department of Religion, Duke University, Box 4735, Duke Station, Durham, North Carolina 27706.

Oxford. The Duke/Oxford Summer Program, a six-week program at New College, Oxford, utilizes the Oxford tutorial system of education. Each student chooses one of several courses of study (e.g., twentieth-century British history, literature, or politics) and works under the direction of a tutor who is a faculty member at the University of Oxford. The tutorial format is supplemented by the lectures given at the Oxford International Graduate Summer School by noted British scholars. Upon successful completion of their course, students receive two 100-level credits from the appropriate departments at Duke. The program is open only to Duke students. Detailed information may be obtained from Dean E. W. Wittig, 105 Allen Building.

Spain. The Duke Study-Travel Program in Spain, a five-week program under the direction of Dr. Garci-Gómez, features a rather extensive tour of historical and monumental Spain and intensive practice with the Spanish language while living with families. The two courses are limited to a dozen students above the

intermediate level. For detailed information write to Dr. Garci-Gómez, Romance Languages, Duke University, Durham, North Carolina 27706.

Germany. The Department of Germanic Languages and Literature cosponsors with Vassar College the German Program Abroad. The program is a six-week living/learning experience in Münster, West Germany, in which classroom instruction and environment reinforce each other. Students live in private homes to gain firsthand experience of German life and thought. All courses are taught by native instructors. Two course credits will be extended for successful completion of the program.

For further information see the course listings in German and contact Professor Helga Bessent, Director of Undergraduate Studies, Department of Germanic Languages and Literature, Duke University, Durham, North Carolina 27706.

Costa Rica. See the Organization for Tropical Studies.

Duke Summer Festival of the Arts—Artsfare 1979

The Duke Summer Festival of Creative Arts is a part of the Summer Educational Programs and an extension of the function of the Office of Cultural Affairs, coordinating the arts in the summer and providing an exciting, artistically stimulating environment for the campus and community. During the summer it is possible to offer new and innovative courses and workshops. Distinguished artists and scholars will be involved in class and cocurricular sessions. Students will have opportunities to try their wings in formal and informal productions.

Specific course listings can be found under drama, music, and physical education and recreation. The range of fees and other information may be obtained by writing Summer Educational Programs, Duke University, Durham, North Carolina 27706.

Summer Drama Program. The Duke University Drama Program, which began its course offerings in the summer of 1974, strives to make its summer offerings particularly exciting and innovative. The course offerings, listed in this bulletin under drama, and the production program of Summer Theater at Duke offer the theater-oriented student an integrated program of training in practical theater and dramatic literature during the first and second summer sessions. This summer, new courses will be introduced in advanced scene study, the contemporary French theater, television acting and directing, and the American film. The professional staff will be joined by the leading authority on contemporary French drama, Wallace Fowlie; and a noted television director, to be announced.

Detailed information on faculty, courses, productions, and auditions may be obtained by writing to Summer Drama Program, Duke University, Box 6936 College Station, Durham, North Carolina 27708.

Summer Theater at Duke. Founded in 1972, Summer Theater at Duke has become an eagerly awaited series of exciting theatrical events. The repertory is chosen from the best in modern theater and musical comedy with an occasional new look at a classic. The casts are selected on the basis of auditions held during late spring. Direction and design are provided by the professional staff of the Duke University Drama Program.

For its eighth season, Summer Theater at Duke will offer four major productions and several special events between 24 May and 15 July 1979. The repertory and ticket information will be announced in late spring. Performances will be in the theater's headquarters in the air-conditioned East Duke Building.

For further information write to Summer Theater, Duke University, Box 6936 College Station, Durham, North Carolina 27708.

Opera. The Duke University Summer Opera Festival is a joint effort of the Department of Music and the National Opera Company, offering four major productions during the first two summer sessions. The festival will open with Puccini's *La Boheme* on 10 June; *Un Giorno di Regno* by Verdi on 17 June; *El Capitan* by Sousa on 24 June; and Mozart's *Don Giovanni* on 1 July. The operas will be presented in Durham's Carolina Theater on Sunday afternoons at 3:00 P.M.

Kneisel Hall Summer School for String and Ensemble Music. By an arrangement between Duke and the Kneisel Hall School in Blue Hill, Maine, it is possible for students to continue their work and to experience intensive training in the art of ensemble playing. During the summer of 1979, instruction will continue from 24 June to 12 August 1979. For information concerning courses see the music listing in this bulletin and contact the Department of Music, Mary Duke Biddle Music Building, Duke University, Durham, North Carolina 27708.

Classical Guitar. During the first summer term, Francis Perry, former Artist-in-Residence at Duke, will return to the campus to offer credit courses in guitar as well as to give open workshops and performances. Mr. Perry's presence on campus offers a special opportunity for guitar devotees.

The American Dance Festival. 16 June–28 July 1979. In the summer of 1978, the American Dance Festival brought together a community of dance students, performers, and dance enthusiasts for its first season at Duke University. The festival had its beginnings in the summer of 1934 when the great pioneers of modern dance, Martha Graham, Doris Humphrey, Charles Weidman, Hanya Holm, and others, then went to Bennington College in search of a place that would serve as a watershed for the developing art of modern dance. The festival remained at Bennington through 1941 except for a summer at Mills College in 1939. Interrupted by World War II, the festival reopened at Connecticut College in 1948.

The growth and diversity of dance in America can be traced through the festival premieres, and by the late 1960s it was evident that dance had come of age, touching and drawing from a variety of new sources. In its Bennington days, the festival served as a mecca for choreographers, many of them now legendary. A whole new generation of dance artists developed in New London, Connecticut, and this process is continuing in North Carolina.

In keeping with the new directions that the art was taking, the festival expanded its programs to meet the needs not only of dancers and choreographers, but also of the dance world as well. The festival will continue to hold its *Critics' Conference*, an intensive three-week seminar designed to expand the knowledge of and interest in dance among professional journalists and a four-week *Dance Television Workshop* which focuses on making professional directors and producers sensitive to the needs of dance. Additionally, the commissioning by the festival of musical compositions for new choreography will be accomplished through *Project Music and Dance*, a program of mutual cooperation between two noted American composers and two choreographers from leading dance companies. Workshops for dance therapists and dance educators and the week-long conference of the National Endowment for the Arts *Artists-in-Schools* dance component which is attended by dance educators, administrators, dance companies, state arts agency representatives, and participants in the Dance Touring Program, will also be held.

In addition to the programs on the Duke University campus, a special program of classes and workshops aimed at encouraging community involvement in dance are offered in various locations in the Triangle area and over the state of North Carolina.

Completing the total dance program is an outstanding series of twenty-five performances by the world's leading dance companies, presented in Page Auditorium. It is this aspect of the festival which has immeasurably enriched the cultural life of the state and region.

For further information, write the American Dance Festival, Duke University, Box 6097, College Station, Durham, North Carolina 27708. For listing of course offerings see Courses of Instruction.

Short Courses and Conferences

The Ministerial Course of Study School. In cooperation with the Board of Ordained Ministry and the Southeastern Jurisdictional Conference of the United Methodist Church, Professor William H. Willimon directs the Ministerial Course of Study School. This is not related to regular Divinity School degree programs, and no credit toward a seminary degree can be earned. The thirtieth session of the school is from 25 June to 20 July 1979. For further information, write the Director, Box 4484, Duke Station, Durham, North Carolina 27706.

Divinity School Institute for Ministry. Seminars and clinics running concurrently, for ministers, spouses, and church leaders of all denominations, will be conducted at the Duke Divinity School 7-11 May and 14-18 May 1979. These are designed to supplement seminary education through one or two weeks of intensive training in academic and professional studies. No academic credit is given.

Sponsoring institutions make funds available for tuition. Other scholarships are available upon request. For full information write the Director of Continuing Education, Duke Divinity School, Durham, North Carolina 27706.

Southeastern Institute of Medieval and Renaissance Studies. Participation in the Southeastern Institute of Medieval and Renaissance Studies is open to those with scholarly interest in all areas of medieval and Renaissance studies, including (among others) art, aesthetics, history, literature, music, paleography, philosophy, and religion. The institute consists of five informal seminars, each concerned with a topic of interest to students of medieval and Renaissance periods. Each seminar is led by a senior fellow and has an enrollment of about six participants, designated as fellows. Each fellow participates in one seminar and has ample time to devote to individual research. It is emphasized that the seminars are not courses but informal meetings to encourage the exchange of ideas and to stimulate participants in their own research. Most fellows will be beyond the Ph.D. level but in some cases applications will be considered from advanced graduate students. The public is invited to attend a series of lectures on medieval and Renaissance topics during each session of the institute.

Annually the institute alternates between the campuses of Duke University and the University of North Carolina at Chapel Hill. The tenth session will be held on the University of North Carolina campus and it will run for six weeks, 2 July through 10 August 1979. For more information, write Dr. Frank Tirro, Chairman, Southeastern Institute of Medieval and Renaissance Studies, Duke University, Durham, North Carolina 27708.

Summer Institute of Alcohol Studies. This institute (22-27 July 1979) will offer the following substance abuse workshops: Clergy Training, Employee Assistance, Peer Counseling, Community Health Nursing, Management Skills, Minorities Training, Youth Alcohol Awareness, and Physicians and Medical Personnel Training. Each workshop will be limited to a maximum of twenty-four participants. Participants will receive intensive training in one area of their choice

and plenary sessions will be held on topics of general interest. Participants must agree to stay on campus except in rare circumstances.

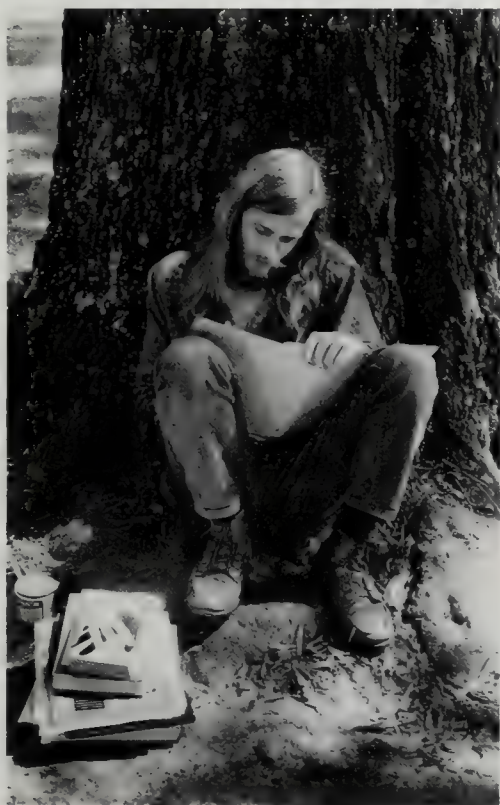
For a brochure and complete information, write to Fritz Anlyan, Administrative Coordinator, Summer Educational Programs, 06B West Duke Building, Duke University, Durham, North Carolina 27708.

Short Course on Energy Conservation in Buildings. This course, sponsored by the Center for the Study of Energy Conservation and Duke Summer Educational Programs, is designed to assist personnel from public and private schools and colleges to develop a rational program of energy conservation. The lectures and discussions will provide a factual overview of the supply and use of energy in the United States and this region, a comprehensive treatment of energy conservation methods in existing buildings and new building construction, and a detailed discussion of how to establish and conduct an effective energy management program.

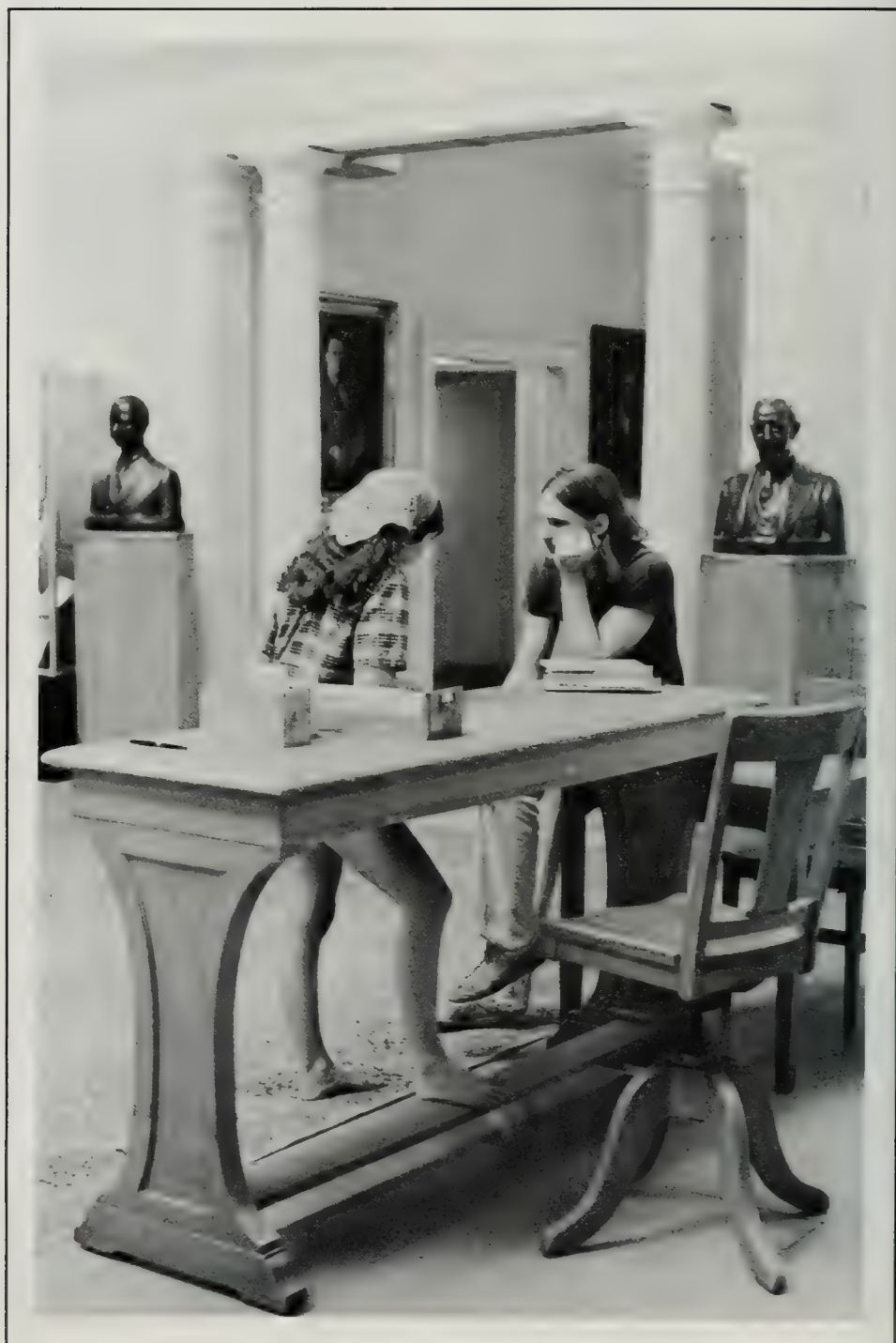
Dr. Jack Chaddock, Director of the Center for the Study of Energy Conservation, and Dr. Ish Sud of the center will conduct the short course from 15 May-17 May 1979. For complete information write Fritz Anlyan, Administrative Coordinator, Summer Educational Programs, 06B West Duke Building, Duke University, Durham, North Carolina 27708.

Seminar on Federal Regulations in Higher Education. This seminar, sponsored by Duke Summer Educational Programs, is designed to assist administrative personnel from public and private colleges and universities in understanding various federal regulations as they apply to higher education. The presentations and discussions will focus on nondiscrimination regulations as they apply to employees and students; tax issues; and general topics including lobbying legislation, V.A. regulations, personal and trustee liability, and student consumer issues. The consultants will be prepared to answer questions from seminar participants.

Consultants for the seminar are: Estelle Fishbein, General Counsel at Johns Hopkins University; R. Claire Guthrie, Assistant Secretary and University Counsel at Princeton University; Sheldon Steinbach, Staff Counsel and Assistant Director of Governmental Relations, American Council on Education; Laura Ford, Assistant Director of Governmental Relations, American Council on Education; and Bruce R. Hopkins, partner in the firm of Hewes and Hopkins, Washington, D.C. and author of *The Law of Tax-Exempt Organizations*. The seminar will be conducted from 22 May-24 May 1979. Enrollment will be limited to forty participants. For complete information, write Fritz Anlyan, Administrative Coordinator, Summer Educational Programs, 06B West Duke Building, Duke University, Durham, North Carolina 27708.



Resources for Study



University Libraries

The Library System. The libraries of the University consist of the Perkins Library and its eight branches on campus: Biology-Forestry, Chemistry, Divinity, East Campus, Engineering, Music, Physics-Math, and Undergraduate; and the Pearse Memorial Library at the Duke Marine Laboratory in Beaufort; the Law Library; and the Medical Center Library. In June 1978, these libraries contained approximately 2,900,000 volumes and ranked nineteenth in size among academic libraries in the United States. More than 14,000 periodicals, 20,000 serials, and 200 newspapers are received regularly. The collection includes about 5,000,000 manuscripts, 80,000 maps, 35,000 sheets of music, and 280,000 items on microfilm.

The William R. Perkins Library—the main library of the University—houses most of the books and journals in the humanities and social sciences, large files of United States federal and state documents, public documents of European and Latin American countries, publications of European academies and learned societies, and special collections from South Asian, Far Eastern, and Slavic countries. The newspaper collection, with 16,000 volumes and 30,000 reels of microfilm, has several long eighteenth-century files; strong holdings of nineteenth-century New England papers; and antebellum and Civil War papers from North Carolina, South Carolina, and Virginia as well as many European and Latin American papers. The manuscript collection of approximately 5,000,000 items is particularly strong in all phases of the history, politics, and social and economic life of the South Atlantic region, and includes significant papers in English and American literature. The rare books collection contains many scarce and valuable materials covering a broad range of fields. The collection of Latin and Greek manuscripts constitutes one of the outstanding collections of its kind in the United States. The collection of Confederate imprints is the largest in the country.

The branch libraries serve the academic disciplines which bear their names. The East Campus Library is primarily for undergraduate use but also contains the principal collections for graduate and undergraduate study in art.

Tours of the Perkins Library are given frequently. Information about other campus libraries may be obtained from the staff in each of the libraries. Handbooks about library services and facilities are also available in each of the libraries.

The School of Law Library. The law library, with over 240,000 volumes (twenty-sixth in size among law school libraries), serves both the University and the local legal community. The collection contains nearly all reported decisions of the federal, state, and territorial courts of the United States, British Commonwealth,



and representative foreign jurisdictions. It also includes the constitutions, codes, statutes, and subsidiary legislative publications of all of these jurisdictions as well as many digests, indexes, bibliographies, and related research tools. A large section of the library collection is devoted to treatises on all phases of law and legal sciences and works in the field of history, economics, government, and other social and behavioral sciences relevant to legal research. There are files of selected federal documents, and since 1970 a complete set of congressional materials has been maintained. The Christie Jurisprudence Collection is located in the main reading room. Other collections include legal history, administrative materials, intellectual property, criminal procedure, school law, and briefs of the United States Supreme Court, the Fourth Circuit Court of Appeals, and the North Carolina Supreme Court and Court of Appeals. Undergraduate students whose course of study

requires access to the law literature should obtain permission from the law librarian to use the collections.

The Medical Center Library. Located in the Seeley G. Mudd Communications Center and Library Building, provides the services and collections necessary to further educational, research, and clinical activities in the medical field. In addition to faculties and students in the Schools of Medicine, Nursing, and Allied Health, and Medical Center graduate departments, the library serves the professional and technical staffs at Duke Hospital as well as other health professionals throughout North Carolina. Over 160,000 volumes are available and about 2,850 journals are currently received.

The history of medicine collections, including the Josiah C. Trent Collection, consist of rare books and manuscripts and a supporting group of histories, biographies, bibliographies, pictures, and ephemeral materials. The rare books are available to all, but are restricted to library use. Most modern books may be borrowed. The history of medicine collections also include the Duke Authors Collection which preserves an archival copy of each book published by a member of the Duke medical faculty. The Frank Engel Memorial Collection consists of a small group of books on nonmedical subjects, supplemented by several newspapers and popular magazines. A reserve collection of heavily used books and journals is maintained in the medical sciences branch library located in the Nanaline Duke Building and covers the fields of biochemistry, genetics, pharmacology, and physiology.

Other Resources

In addition to the laboratories, classrooms, computers, and other basic facilities of a modern teaching and research university, Duke has a number of more specialized facilities and cooperative programs. Among the more specialized resources are the Duke Forest, the Sarah P. Duke Gardens, the Primate Center, and the Field Station for the Study of Animal Behavior. The Duke University Marine Laboratory located at Beaufort, North Carolina, includes, in addition to its extensive teaching and research facilities, the Cooperative Oceanographic Program which maintains the research vessel *Eastward*. On the Durham campus are located the phytotron, a unit of the Southeastern Plant Environmental Laboratories, and the Triangle Universities Nuclear Laboratory. Also, during the summer, arrangements for study exist with the Kneisel Hall Summer School for String and Ensemble Music, the American Dance Festival, the Organization for Tropical Studies, and the Highlands Biological Laboratory. For a more extensive listing and description of the educational resources of Duke University, please see the graduate and undergraduate bulletins.

Student Life



Living Accommodations

Duke University provides residence hall accommodations on West Campus for graduate and undergraduate students enrolled in the summer session. Efforts are made to house all students in air-conditioned facilities, but because these are limited, use of non-air-conditioned facilities may become necessary.

Air-conditioned apartments are available for single students and married students accompanied by their families. Units in the new Central Campus Apartments and Town House Apartments will be used.

Information for each type of residential accommodation may be obtained by writing the appropriate Manager whose address is found in the chapter on Financial Information.

Dining Service. Food service is cafeteria style. The cost of meals depends on the needs and tastes of the individual. The dining facilities on the West Campus may be used for the regular summer session students. The cafeteria in Trent Drive Hall is open for lunch Monday through Friday, and Gradel's is open from 8:30 A.M. to 6:30 P.M. Monday through Friday.

Duke University Marine Laboratory. The Duke University Marine Laboratory, located on Pivers Island, has cottage-type residence halls which will be available for summer session students. Further information may be obtained from the *Bulletin of the Duke University Marine Laboratory*.

Services Available

Medical Care. The Student Health Service, located in the Marshall I. Pickens Rehabilitation Center, operates during the summer session and, except for hospitalization in the University infirmary, offers the same medical and surgical services available to full-time students during the academic year as described in the *Bulletin of Information and Regulations*. Use of the Student Health Service is restricted to matriculated students. Presentation of a current student identification/enrollment card is required.

All students are charged a health fee for each summer term. See the section in this bulletin on Tuition and Fees.

Regular clinic services are available for use from 8 A.M. to 7 P.M., Monday through Friday, and 9 A.M. to 1 P.M. on Saturday at the University Health Clinic, Pickens Building, West Campus, phone: 684-6721.

Counseling and Psychological Services. Counseling and Psychological Services (CAPS) is open to all undergraduate/graduate, professional, and allied health students enrolled at Duke University. CAPS provides a comprehensive and coordinated range of services including evaluation, counseling, and psychotherapy regarding personal problems which relate to family, social, academic, career, and sexual matters. Vocational and educational testing and interpretation are provided upon request as an integral part of the counseling process with regard to career planning.

The professional staff is composed of clinical social workers, psychiatrists, and psychologists who are experienced in working with young adults. Each student who requests an appointment for counseling will have an individual visit initially with a member of the staff to allow the two of them to evaluate the student's concern. Of course, if a student requests a joint appointment with another person, this can easily be arranged. The staff member and the student will identify the most helpful way of resolving the problem, whether that be through individual, couples and/or group counseling, or psychotherapy, or some other means. CAPS maintains a policy of *strict confidentiality* concerning the information about each student's contact with the CAPS staff. If a student desires that such information be released to anyone, he/she must give specific written authorization for such release.

CAPS offers a number of small group experiences focusing on skills development and special interests. These explore such interests as study skills, anxiety reduction, self-career exploration, assertiveness training, sex-role exploration, committed couples, and communication skills. Students interested in such experiences may contact CAPS for further information.

As Duke University's center for the administration of national testing programs, CAPS offers a wide variety of graduate and professional school admission tests and professional licensure and certification examinations. CAPS maintains a library which has a wide selection of vocational and educational program resource materials to assist students in choosing a career and/or further training programs in graduate or professional study.

There are no charges for initial evaluation and/or brief counseling/psychotherapy; however, where extended interviews are indicated, a fee commensurate with a student's financial situation will be arranged on an individual basis. If appropriate, a referral may be made to other staff members or a variety of local resources, including multidisciplinary mental health professionals in private practice and clinic settings.

Appointments may be made by calling 684-5100 or coming by the CAPS office located in Suite 214 Old Chemistry Building, on West Campus next to the medical school, between 8:00 A.M. and 5:00 P.M., Monday through Friday. If a student's concern needs immediate attention, that should be made known to the secretary and every effort will be made to arrange for the student to talk with a staff member at the earliest possible time.

Another important function of CAPS is the availability of the staff to the entire University community for consultation and educational activities regarding student development and mental health issues. The staff seeks to assist other campus personnel including administrators, faculty, residential advisers, religious life staff, and student health staff in meeting whatever student needs are identified through such liaisons.

Office of Placement Services. Duke University maintains the Office of Placement Services which acts as a liaison between the University and potential employers in business, education, and government. All services are offered without charge to students in the summer session who are registered for a degree at Duke University. The staff is available to talk with summer session students about

their professional plans. Students who are eligible to register with the office are offered an opportunity to assemble a complete dossier of academic records and recommendations to supplement applications for positions and to have a permanent file for future reference. Pertinent recommendations should be accumulated during the time the student is enrolled at Duke.

Part-time employment listings for the campus and Durham area are maintained in the office. All students interested in working during the summer session should register at the beginning of the term. Every effort will be made to help each student find a job consistent with expressed interests.

Cocurricular Programs

The academic advantages of attending Duke University during the summer sessions are enriched by programs sponsored by the Office of Cultural Affairs, the Duke University Union, and the Student Activities Office.

The Cultural Affairs Office. This office provides special garden concerts, organ and other recitals, as well as the Quadrangle Pictures showing on Wednesday evenings.

The Duke University Union. The union sponsors social events such as the Happenings on the main quadrangle to inaugurate each session; Thursdays in the Tavern with live music in the University Room where beverages are available; Faculty Forums, a bi-weekly series of talks by distinguished members of the Duke faculty and administration, followed by questions and answers and a social conversational hour; a film series, Freewater Films, with showings one evening a week through Terms I and II; art exhibitions in both Flowers Gallery and the Booklovers' Room, East Campus Library; and a broad program in crafts located in Southgate Dormitory.

The Student Activities Office. This office assists various sporting clubs in planning trips, and sponsors bus or van weekend trips to the beach and mountains.

Recreation

The University offers a recreational program during the summer months which gives all students the opportunity to participate in some form of healthful and informal physical activity. The Aquatic Center will be open daily except Sunday for students and the Card Gymnasium pool will be available for faculty and staff families on Monday and Thursday evenings. The handball, racketball, squash, and tennis facilities and the weight room in the basement of the Aquatic Center are also available. Summer softball and other team sports are available for interested students.

Religious Life

During the summer the Duke Chapel is open daily for prayer and meditation from 8:30 A.M. to 8:00 P.M. The Sunday morning worship in the chapel at 11:00 A.M. is the central focus for the summer ministry. The Chapel Choir is open to those who wish to sing in it, with rehearsals Sunday at 9:30 A.M. The Benjamin N. Duke Memorial Organ is played Monday through Friday, from 12:30–1:30 P.M. Special guest recitals are also scheduled for the summer. The ministers and other members of the chapel staff are available to provide counseling help and other assistance as needs arise.

Publications

The Duke University Calendar. Published at the beginning of each summer session, the official calendar announces all academic, religious, cultural, social, and recreational events for the current term as well as includes official notices concerning academic requirements. The calendar is available in residential units, the summer session office, Flowers information desk, and in the cultural affairs office. Copy for items to be included in the calendar should be submitted in 108 Page (telephone 684-5578).

The Duke Chronicle. The student newspaper is published weekly and is available at various distribution locations near dining hall entrances and the post office area.

The Summer Session Newsletter. The newsletter is published twice weekly by the summer session office and is available at convenient locations.

Conduct of Students

Duke University expects and will require of all its students continuing loyal cooperation in developing and maintaining high standards of scholarship and conduct.

The University wishes to emphasize its policy that all students are subject to the rules and regulations currently in effect or which are, from time to time, put into effect by the appropriate authorities of the University. The student is expected to be familiar with the current *Bulletin of Information and Regulations*, which may be obtained in the Office of Student Affairs, as well as any published regulations for the summer session.

Students, in accepting admission, indicate their willingness to subscribe to and be governed by these rules and regulations and acknowledge the right of the University to take such disciplinary action, including suspension and/or expulsion, as may be deemed appropriate for failure to abide by such rules and regulations or for conduct adjudged unsatisfactory or detrimental to the University. University authorities will take action in accordance with due process.





Admission



Qualifications for Admission

Students in the following categories may be admitted to the Duke University summer session:

1. Graduates and undergraduates who are presently enrolled and in good standing at Duke University.
2. Graduates and undergraduates who have been formally admitted or readmitted to Duke University.
3. Students who are currently in good standing in their respective fully accredited college or university.
4. Teachers in service with or without the bachelor's degree who wish to earn credits for certification purposes.

Admission to specific courses offered in the summer session is governed by the student's academic status (freshman, sophomore, junior, senior, graduate, special, or unclassified) and by the prerequisites of the course in question.

Application Procedures

Duke Students in Residence during the Spring Semester, 1979. A Duke University student, either graduate or undergraduate, who plans to attend the summer session should at the time of preregistration for the fall semester enroll for the desired summer session courses. Undergraduates who have not met the semester continuation requirements for the spring semester are not permitted to enroll in the first summer term. They will be allowed to enroll in the following terms provided the continuation standard has been met.

Undergraduates Not in Residence at Duke during the Spring Semester, 1979. New students seeking to enter Duke University as freshmen or as undergraduates with advanced standing should write the Office of Admissions requesting application forms. Undergraduates who wish to re-enter the University should write to the Associate Dean of Trinity College of Arts and Sciences for application forms.

Undergraduates enrolled in other colleges and universities who desire to earn credits in the Duke University summer session which are to be transferred to their own institutions should apply directly to the Director of the summer sessions, Duke University, using the application form at the end of this bulletin. They should give accurately and clearly all information called for on the application form.

Graduates Not in Residence at Duke during the Spring Semester, 1979.

Students who are seeking admission to the Graduate School and those who have been admitted to the Graduate School must apply to the Director of the summer session on the application form at the end of this bulletin. Those who are seeking admission to the Graduate School must also file Graduate School application forms. These may be secured by writing to the Dean of the Graduate School, Duke University, Durham, North Carolina 27706.

Students who have graduate standing, who are currently employed as teachers, and who wish to earn credits toward renewal or the advancement of their certificates may enroll in the summer session as unclassified graduate students without becoming candidates for a degree at Duke University. See the chapter on Registration and Regulations.

Admission to Degree Candidacy

Undergraduates. A student seeking to enroll as a candidate for the bachelor's degree from a college or school of Duke University must meet the entrance requirements set forth in the *Bulletin of Undergraduate Instruction* and be accepted by the Director of Admissions. This bulletin may be secured by writing the Office of Admissions, Duke University, Durham, North Carolina 27706.

Graduates. A student seeking to enroll as a candidate for one of the advanced degrees offered by the Graduate School of Duke University must meet the

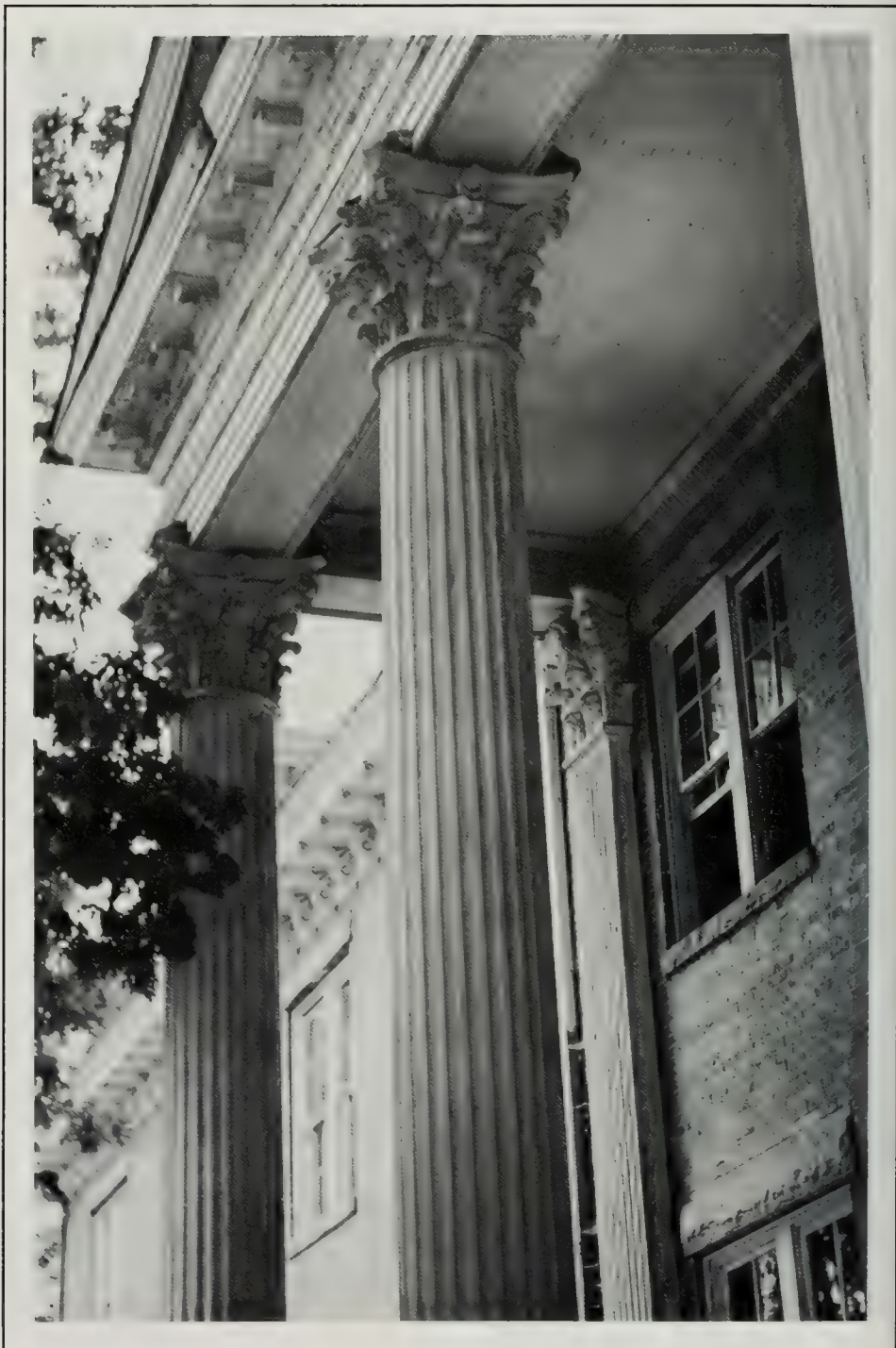


requirements set forth in the *Bulletin of the Graduate School*. This bulletin may be secured by writing to the Office of the Graduate School, Duke University, Durham, North Carolina 27706.

Policy of Nondiscrimination

Duke University does not discriminate on the basis of age, race, color, national and ethnic origin, handicap, or sex, in the administration of educational policies, admission policies, financial aid, employment, or any other University program or activity.

Financial Information



Tuition and Fees

1. Tuition for undergraduates—\$330* for each nonlaboratory course, \$440* for each undergraduate laboratory course, and \$660 for each one and one-half course program offered at the Marine Laboratory.
2. Tuition for graduate students—\$110* per unit; for an undergraduate course, the tuition rate is as indicated in paragraph one above.
3. Tuition for physical therapy students—\$137* per unit.
4. Tuition for graduate nursing students—\$140* per unit.
5. All students are required to pay an \$18 health fee per term; graduate students who are only in residence for Terms I, II, and III are required to pay \$27 which covers all three terms.

Laboratory Fees. For Marine Laboratory investigators' research table fee, see the Marine Laboratory bulletin. A fee of \$10 will be charged for DRA 109 and 189.

Studio Fee. A fee of \$40 will be charged for each art class.

Medical Mycology Fee. Noncredit registration fee of \$250; tuition for credit registration is as indicated in paragraph two above.

Greens Fee. A fee of \$25 is charged for PE 30.

Auditing Fees. These fees are as follows:

1. Students registered for a full course program (two courses) may audit nonlaboratory courses, except PE courses, (with the permission of the instructor and the director) at no extra charge.
2. Students carrying less than a full course program may be granted permission by the instructor and the director to audit a course but must pay half the University fee for the course.

Late Registration Fee. Students who fail to register prior to the first class day of a given course will pay an extra charge of \$25.

Payment of Tuition and Fees. The summer session office does not mail statements for summer session tuition and fees. All tuition and fees should be paid in the bursar's office prior to the first day of classes. Students registering by mail may forward payment to the Office of the Summer Session, 120 Allen Building, Duke University, Durham, North Carolina 27706.

Refund for Tuition and Fees. Tuition and fees will be refunded under the following circumstances (except for foreign programs):

*This is a projected figure and subject to change prior to the beginning of the 1979 summer session.

1. When applications for withdrawal are received by the Director of the summer session before the first class day of a given term of the summer session, full tuition and fees will be refunded.
2. When applications for withdrawal are received by the Director of the summer session during the first three class days of a given term, 80 percent of the tuition will be refunded. The health fee will not be refunded.
3. When applications for withdrawal are received by the Director of the summer session after the third class day, there will be no refund of tuition and fees.

Debts. No grades will be processed, no records will be released, and no student will be considered by the faculty as a candidate for graduation until all tuition and fees have been paid and indebtedness has been settled with the Bursar.

Living Accommodations

Rates for Residence Hall Space for Each Summer Term*

	<i>All Courses Except Medical Mycology</i>	<i>Medical Mycology</i>
Single Occupancy†	\$165	\$145
Double Occupancy†	122	108

*Rates for non-air-conditioned space when used will be somewhat lower.

†All prices are subject to change.

Rates for one-, two-, or three-bedroom apartments vary according to the type unit desired and the number of persons occupying the apartment. Linen rental



service is available through the student laundry on West Campus. No housewares are available for use in apartments.

For detailed information on types of accommodations available at Duke University for the summer session write (for residence halls): Manager of Residence Halls, Department of Housing Management, Duke University, Durham, North Carolina 27706; and (for apartments): Manager of Apartments and Property, Department of Housing Management, Duke University, Durham, North Carolina 27706.

Estimated Cost of One Term of the Summer Session

University tuition, two nonlaboratory courses or 6 graduate units	\$660.00 *
Health fee	18.00
Residence hall fees (double room for one term)	122.00
Books and class materials (average)	70.00
Miscellaneous (laundry, etc.)	30.00 †
	<hr/> \$900.00

Meals are cafeteria style; costs will vary according to individual tastes and needs.

*This is a projected figure and subject to minor change prior to the beginning of the 1979 summer session.

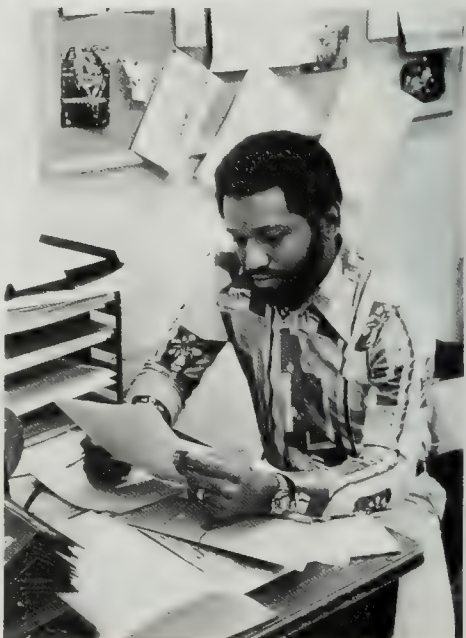
†Approximate costs will vary according to individual needs.

Student Aid

Financial Aid. A limited amount of financial aid is available to students in summer study. Summer financial aid, determined according to demonstrated need, may consist of institutional grant funds and/or low interest loans from the Federally Insured Student Loan program and the National Direct Student Loan program. To qualify for summer school aid, a student must be enrolled, or accepted for enrollment at Duke during the academic year immediately preceding or immediately following the summer for which aid is requested. (Students enrolled only for the summer may be eligible to borrow from an outside lender under the Federally Insured/Guaranteed Loan program in their home state or from the school at which they are regularly enrolled. They should contact their college's financial aid office or the State Department of Higher Education for information and applications.) Applications for aid should be submitted to the financial aid office no later than the week before the beginning of each term. The type and amount of aid awarded will be determined by the financial aid office based upon the student's financial need and the availability of funds. The granting or withholding of aid is a matter entirely within the discretion of the financial aid office.

Loans. Loans are available through one of two federal loan programs. Eligibility for these loans is based on the federal requirement that financial need be demonstrated via the financial aid form or any other needs analysis system accepted by the federal government and approved for use by Duke University.

Employment. A limited number of job opportunities are available through the college work-study program. The financial aid office does not include employment as a part of need-based summer aid packages. When, however, in the judgment of the student and the Aid Officer, the student's academic program allows sufficient time for employment, the student will be encouraged to accept employment in the place of a loan.



Inquiries concerning need-based financial aid availability and application procedures should be directed to the Office of Undergraduate Financial Aid, Duke University, Durham, North Carolina 27706 or to the Financial Aid Officer of the appropriate graduate division.

Tuition Grant for Children of the United Methodist Church. Children of ministers in the North Carolina and the Western North Carolina Annual Conferences of the United Methodist Church may be eligible to receive a partial grant. Eligibility is met by the parent being in a regular pastoral appointment and resident in one of the conferences. When the parent is in a special appointment and resident in one of the conferences, eligibility will be determined on an individual basis, depending upon the nature of the appointment. In all cases the decision of the University will be final. For further information, contact Frances Baker in the undergraduate financial aid office.

Tuition Grants. Tuition grants are available to children of faculty and qualified staff members of Duke University. Information regarding the tuition grant program may be obtained by writing to the Director of Undergraduate Financial Aid, at the above address.

Scholarships, Fellowships, Traineeships, and Fringe Benefits. It is the responsibility of the student to make arrangements with the appropriate office or department and to make certain that payment or a code notice covering tuition and fees is supplied to the Bursar, 101 Allen Building.

Athletes contact Ruby McLawhon (103 Indoor Stadium).

Teachers contact the Director of Graduate Studies, Department of Education (West Duke Building).

Employees, including faculty, contact Harrison Brooke or Thomas Mann (303 Allen Building).

Spouses and children of faculty and senior administrative staff in undergraduate degree programs contact Frances Baker in undergraduate financial aid (2138 Campus Drive).

Spouses of faculty and senior administrative staff not in degree programs contact Harrison Brooke or Thomas Mann (303 Allen Building).

Questions concerning eligibility for fringe benefits should be addressed to Harrison Brooke or Thomas Mann (303 Allen Building).

Registration and Regulations



Definition of Terms

Registration. Students have completed registration for the summer session when:

1. Their course programs have been written and approved by their adviser or academic dean in the school or college in which they are enrolled or by the Director of the summer session in the case of the special or unclassified student.
2. University fees for the summer session have been paid; a place in a course cannot be assured until this has been done.

Tuition bills are not sent to students' homes. These are available in the bursar's office.

General Registration

A student attending the summer session must complete registration in the summer session office, 120 Allen Building, on or before the Friday preceding the first class day of the given term (Term I, Friday, 4 May; Term II, Friday, 8 June; Term III, Friday, 13 July).

Late Registration

Any student who fails to register before the dates specified in the preceding paragraphs will be charged a fee of \$25 for late registration. All late registrations and course changes must be completed by the end of the third class day of each term (10 May, Term I; 13 June, Term II; and 18 July, Term III). All course changes and late registration must be approved by an academic dean of the school or college in which the student is enrolled, or, in the case of the special or unclassified student, by the Director of the summer session.

Since summer session courses present a program of study in more concentrated and rapid form than in the regular semesters, students are advised to register on time and to be present at all class sessions.

Advanced Registration

Students in Residence During the Spring Semester, 1979. Graduate and undergraduate students in residence at Duke University during the spring semes-

ter, 1979 who plan to enroll for courses or research in one or more terms of the 1979 summer session will write course programs and have them approved in their respective schools or college during the week of preregistration, 26–28 March 1979. Any student in residence, whose course programs have been written and approved by their respective schools or college on the date indicated above, may complete their registration by paying their tuition no later than the Friday preceeding the start of the desired term. A student who desires to attend the summer session but who did not preregister should complete registration by the Friday preceding the beginning of the desired term.

Students Not in Residence at Duke During the Spring Semester, 1979.

Students not in residence at Duke University during the spring semester, 1979—new undergraduate students seeking to enter as degree candidates, graduate students who are not candidates for an advanced degree at Duke University, and students of other colleges and universities desiring to earn credits for transfer—may register by mail. Advance registration by mail includes:

1. Completion in full of the application at the end of this bulletin.
2. Admission to the summer session by the Director of the summer session and, in case of a student seeking to enter Duke University as a degree candidate, admission by the Admissions Director to the school or college of Duke University concerned.
3. Payment of tuition by at least one week prior to the beginning of classes. Students who have not completed registration by mail for courses in Terms I, II, and III should complete their registration in the summer session office, 120 Allen Building, by the Friday previous to the first class day of Terms I, II, and III.

Registration of Graduate Students. Graduate students in residence during the spring semester will register for one or more terms of the summer session on 24–25 March. Newly admitted graduate students who have not completed their registration by mail should present themselves for registration at the official registration periods.

Graduate resident students in the spring semester who intend to remain in residence during one or more of the three summer session terms without registering for course work must register for 1 unit of research with the Graduate School.

Academic Regulations

Types of Course Enrollment. Summer session courses may be taken for credit or may be audited. A student's program may be exclusively in one of these categories, or a combination of the two. Students taking a full or partial program for credit may enroll as auditors in any number of additional courses.

The summer session term *credit* does not mean degree credit at Duke University unless the student has been admitted as a degree candidate by one of the colleges or schools of the University. A student taking a course for credit is expected to do all the work required and to take the final examination, and will receive a grade. G.I. Bill benefits are available only to those veterans who enroll for credit.

An auditor is entitled to listen to lectures and class discussions, but may not participate in discussions or take examinations. A student carrying a full program for credit may be given permission to audit as many courses as desired without additional fees. Students carrying less than a full program for credit may secure permission to audit but are required to pay the auditing fee, which is half the regular fee.

Credits. The majority of summer session courses carry one course or 3 graduate units of credit and require one term in residence.

For regulations concerning the application of graduate credit earned elsewhere to a graduate program here, consult the *Bulletin of the Graduate School*. See the chapter, Program Information, for information concerning the Cooperative Program with the University of North Carolina (also including North Carolina State University and North Carolina Central University).

Professional credits toward teacher's certificates are granted by the various state boards of education, each in accordance with its own carefully planned rules. Teachers in service, before enrolling for certification credit, should consult the rules laid down by their State Board of Education. If necessary, they should send to their State Board of Education a list of the courses in which they plan to enroll and inquire whether these will be acceptable for certification credit.

Maximum Course Program. The maximum program for one term of the summer session is two nonlaboratory courses or one laboratory course. In addition a student may enroll in a physical education activity course for .5 credit.

Dropping of Courses. During the first three days of classes in any term, a student may add or drop a course with the permission of the instructor. Thereafter, no course may be added. A course may be dropped without penalty, however, until the end of the second week of each term with the permission of an academic dean and with a *WP* or *WF* grade assigned by the instructor. (The permission of the Director of the summer session is required for students from other universities or colleges.) Courses dropped after the second week are ordinarily assigned an *F* grade, as are courses dropped without permission.

Grading. Only a student taking a course for credit will receive a grade. The grade given represents the quality of the work done in the course.

Passed. The following are passing grades for undergraduates and graduates:

Undergraduate Grades

- A—exceptional
- B—superior
- C—satisfactory
- D—low pass

Graduate Grades

- E—exceptional
- G—good
- S—satisfactory

Although the *D* grade represents low pass, in Trinity College not more than two courses passed with *D* grades may be counted among those required for year-to-year continuation or among the thirty-two courses required for graduation. Courses for which a *D* grade is earned, however, satisfy distributional requirements, as well as requirements in the major, in English composition, and in small group experiences. Trinity College students may not repeat for credit any course in which a *D* grade or higher was earned.

Failed. A grade of *F* or *U* (see pass/fail option below) indicates that the student has failed the course. The grade is recorded on the student's record, and the student receives no credit for the course. If the student registers for the course again, a second entry of the course and the new grade are made on the record, but the first entry is not removed.

Pass/Fail Option. With the consent of the instructor and faculty adviser, an undergraduate student who has declared a major may choose to be graded on a pass/fail basis in one elective, nonmajor course each summer. In addition, with the consent of the instructor, adviser, and Director of Undergraduate Studies, a student may take for pass/fail credit courses in independent study or internship in any department including that of the major. Certain internships and small group experiences will be offered only on a pass/fail basis. Students may change to the pass/fail option only during the first three class days of each term.

Student Request for Assignment of a Temporary Incomplete. If because of illness, emergency, or other reasonable cause, a student cannot complete work for a course, the student may request in writing the assignment of a temporary *I* (incomplete) for the course. If the request is approved by the instructor in the course and by the student's academic dean, then the student must satisfactorily complete the work prior to the last day of classes of the subsequent semester of enrollment or a grade of *F* will be recorded for the course. If the incomplete becomes a factor in determining continuation in the college, it must be satisfactorily completed prior to the beginning of classes for the fall semester.

Absence from Final Examination. The grade of *X* indicates that the student was absent from the regularly scheduled examination. A student absent from examination (if the absence has been excused by an academic dean of the college or school in which the student is enrolled or, in the case of the special or unclassified student, by the director of the summer session) may receive an examination upon the payment of \$5 to the bursar of the University. The instructor concerned arranges for the examination in cases where absences are excused. A student with an *X* grade who has not obtained a passing grade before the end of the next semester of enrollment following that in which the *X* was incurred receives an *F* grade. The course must be repeated in order to receive credit. If the absence from an examination is not excused the grade for the course concerned is recorded as *F*.

Examinations. Final examinations in courses are held on the last two days of each term. Final examinations for short courses will be held on the last day of the course.

Continuation Requirements. A student must achieve a satisfactory record of performance during the summer session in order to maintain enrollment at Duke. Students regularly enrolled who fail more than one course in a summer term or in a summer session will be excluded from the college. Where continuation from the summer session into the fall semester is in question, incomplete work in any course is considered failure to achieve a satisfactory performance in that course. Such courses must be completed in time for final grades to be submitted to the registrar no later than the day preceding the first day of classes for the fall semester. No student who has one *I* or *F* grade in the summer session in combination with one *I* or *F* grade in the preceding spring term may continue into the fall semester.

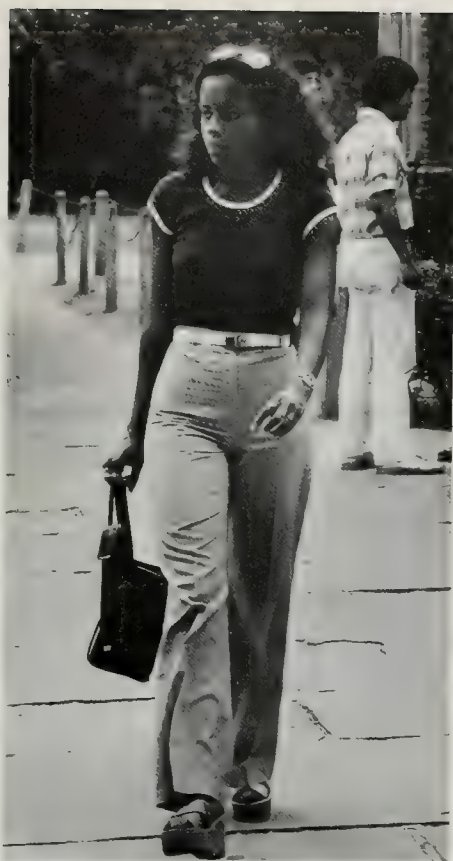
A student in the School of Engineering must pass at least three courses in each semester, except for the first semester of the freshman year, in which at least two courses must be passed. A student who fails to meet this continuation requirement must leave the University for at least two semesters. A complete (3 terms) summer session may be counted as a semester.

A student from another university or college may be dismissed by the director of the summer session for failure to exhibit satisfactory performance.

Withdrawal from the Summer Session. If students wish to withdraw from the summer session, they must consult both the dean of the school or college in which they are registered and the director of the summer session. For students withdrawing on their own initiative prior to established deadlines, a *W* is assigned in lieu of a regular grade for each course. Thereafter, an *F* is recorded for each course unless withdrawal is caused by an emergency beyond the control of the student.

Motor Vehicle Regulation

Students enrolled in the summer session must register their motor vehicles with the traffic control office, 2010 Campus Drive, West Campus.



Courses of Instruction



Course Enrollment

Introductory-level courses are numbered below 100; advanced-level courses are numbered 100 and above. Courses numbered 1–49 are primarily for freshmen; courses numbered from 200–299 are primarily for seniors and graduate students.

Minimum Enrollment Required. Some courses are offered subject to minimum enrollments. The University reserves the right to withdraw any graduate or undergraduate course in which enrollments are minimal. In withdrawing a course, the University attempts to avoid undue hardships on students. Sometimes, therefore, courses are offered in spite of small enrollments.

Summer Session Schedule of Classes

Summer session classes will meet Monday through Friday each week. Saturdays during each term are available for conferences or special class work.

Class Periods are as follows:

First Period: 8:00 A.M. to 9:30 A.M.

Second Period: 9:50 A.M. to 11:20 A.M.

Third Period: 11:40 A.M. to 1:10 P.M.

Fourth Period: 1:30 P.M. to 3:00 P.M.

TBA—Class time and meeting place to be arranged. It is the responsibility of the student to contact the professor or the departmental office not later than the first day of class.

The meeting place for a course is indicated immediately after the class period for the course. Building designations are as follows:

East Campus (E)

A—West Duke
B—Carr
C—Science
D—East Duke
E—Biddle

F—Bivins
G—Branson
H—Art
I—Ark
J—Gymnasium

West Campus (W)

3—Gray
4—Perkins

53—Allen
56—North

5—Foreign Languages
6—Old Chemistry
7—Divinity
9—Sociology-Psychology
10—Social Sciences
17—Card Gymnasium
47—Engineering
49—Physics

58—Biological Sciences
59—Law
65—Gross Chemical Lab
IM—Intramural Building
AQ—Aquatic Center
CG—Card Gym
GC—Golf Course
CH—Chapel
HH—Hanes House

Medical Center (M)

BB—Bell Building
DN—Davison
JN—Jones

MB—Sands
MS—Nanaline H. Duke
SN—School of Nursing

Campus maps may be purchased at the Duke University store magazine counter in the West Campus Union.

Footnotes. The following references are used in the course descriptions:

- A. Permission note is required at the time of registration.
- B. Majors only.
- C. This course is cross-listed in another department.
- D. Graduate students only.
- E. This course has a lab.
- F. This course has a lab and recitation.
- G. Twentieth-Century American Program students only.
- H. Student teachers only.
- I. Course taught at Marine Laboratory—Beaufort, North Carolina.
- J. Additional fee required.
- K. Register for lab section—lecture automatic.
- L. Pass/fail only.
- M. Freshman and sophomore only.
- N. Prerequisite: Mathematics 31 and 32.
- O. Summer Program in Germany.
- P. Check prerequisite.
- R. Check for additional times.
- S. Course taught off campus.
- T. Skill course.
- U. Junior and senior only.
- V. Kneisel Hall School for String and Ensemble Music.
- W. Eight-week course.
- X. Application must be made to the Marine Laboratory.
- Y. Summer Program in Spain.
- 1. Summer Program in Mexico.
- 2. Course for special program dealing with the South.
- 3. Course in Ethics and the Professions Program.

Classes meet daily unless otherwise noted.

Anatomy (ANA)

Professor Robertson, *Chairman* (466 Sands Building); Associate Professor Hall, *Director of Graduate Studies* (250 Sands Building)

151. Anatomy of the Lower Extremities as it Relates to Locomotion. Dissection of the human adult lower extremity. Demonstration and discussion of

gait, biomechanics, and kinesiology. One course. *Bassett*. Term I. 9:50–11:20. MBB, 013

Anthropology (AN)

Professor Fox, *Chairman* (03 North Building); Professor Quinn, *Director of Graduate Studies* (020 North Building); Professor O'Barr, *Director of Undergraduate Studies* (104 North Building)

94. Elements of Cultural Anthropology. The dynamics of culture and society; form and function of social institutions. Emphasis is upon primitive societies. One course. *Apte*. Term I. 9:50–11:20. W56, 012. *Chordas*. Term III. 8:00–9:30. W56, 012

145. Medical Anthropology. Evolution and disease, theories of disease and healing; and factors influencing behavior in health and illness. One course. *Chordas*. Term III. 9:50–11:20. W56, 012

193.25. Independent Study: Kinship, Culture, and Social Change in the South. Kinship patterns and cultural institutions of blacks and whites in the rural South; the impact of urban migration on rural culture and family structure; southern adaptations to the city. A class fieldwork project will focus on a local community. One course. *Jones*. Term I. 11:00–12:30. W4, 421

Art (ART)

Professor Spencer, *Chairman and Director of Graduate Studies* (112A East Duke Building)

53. Drawing. Directed approaches to practice in life drawing and in the expression of graphic concepts. Prerequisite: consent of instructor. One course. *Pratt, V.* Term I. Footnote: J,T. 9:50–12:30. EH, 201

54. Two-Dimensional Design. Experiments in form and color, with work from observation. Introduction to color theory in painting and two-dimensional media. Prerequisite: Art 53 or consent of instructor. One course. *Pratt, V.* Term I. Footnote: J,T. 1:30–4:10. EH, 203

62. Introduction to the History of Architecture, Painting, and Sculpture. Not open to graduating seniors. One course. *Kinkead*. Term I. 9:50–11:20. EB, 207

153. Painting. Studio practice in painting with individual and group criticism and discussion of important historic or contemporary ideas. Prerequisites: Art 54 (or equivalent) and consent of instructor. One course. *Pratt, V.* Term I. Footnote: J. 1:30–4:10. EH, 203

155. Advanced Drawing and Color. Work from life or in formal modes, with emphasis on personal development, through individual and group criticism and discussion. Prerequisites: Art 53 and 54 and consent of instructor. One course. *Pratt, V.* Term I. Footnote J. 9:50–12:30. EH, 201

181. Individual Project. Independent work open to highly qualified seniors on recommendation of the instructor and invitation of the department. One course. *Pratt, V.* Term I. Footnote: J. TBA. EH, 201

191.02. Independent Study: The South. Concentration on American vernacular architecture and the ways in which uses of space relate to an understanding of the history of this region. Part of joint program, The South, directed by Professor Sydney Nathans. One course. *Brown*. Term I. Footnote: 2. 11:00–12:30. W4, 346

Biochemistry (BCH)

Professor Hill, *Chairman* (255 Nanaline H. Duke); Professor Richardson, *Director of Graduate Studies* (213 Nanaline H. Duke)

210. Independent Study. A tutorial designed for students who are interested in either a laboratory or a library project in biochemistry. Credit to be arranged. *Staff*. Terms I, II, III. Footnote: A. TBA

276. Comparative and Evolutionary Biochemistry. Lectures and discussion of the origin of life, evolution of genetic code, mutation and protein polymorphism, natural selection and protein structure, and comparison of homologous proteins and nucleic acids. Laboratory work involves the purification and characterization of homologous proteins from fish and invertebrates. Techniques include salt fractionation, electrophoresis, ion-exchange and molecular exclusion chromatography, fingerprinting, molecular weight determination, amino acid composition, and other related approaches. Prerequisite: consent of instructor. (Given at Beaufort.) One and one-half courses. (6 units.) *Sullivan*. Term II. Footnotes: I,X. TBA

Biology* (BIO)

14. Principles of Biology. A one-semester introduction to the discipline open to freshmen with at least one year of biological science in high school and to all upperclassmen. Lectures and laboratories. One laboratory course. *Hellwig*. Term I. Footnote: E. 9:00–12:30. W58, 154

Botany (BOT)

Professor White, *Chairman* (149 Biological Sciences); Professor Strain, *Director of Graduate Studies* (136 Biological Sciences); Professor Philpott, *Director of Undergraduate Studies* (351 Biological Sciences)

During the summer terms, the department offers a limited number of courses in addition to the opportunity for independent study and research on the Durham campus and the Duke Marine Laboratory at Beaufort. For summer courses in related fields of study, see departmental listings or the *Bulletin of the Duke University Marine Laboratory*. For the broad array of botany course offerings during the academic year as well as degree programs and requirements for candidacy for degrees, students are referred to the *Bulletin of Undergraduate Instruction* and the *Bulletin of Graduate Instruction*. For additional information see or write to the Directors of Undergraduate and Graduate Studies as listed above.

103L. General Microbiology. Classical and modern principles of the structure, physiology, and genetics of micro-organisms and their roles in human affairs. Prerequisite: one course in a biological science or consent of instructor. (Also listed as Microbiology 103L.) One laboratory course. *Johnson*. Term II. 9:00–12:00. W58, 0083

142L. Systematics. Principles of vascular plant taxonomy with practice in identification of local flora. Lectures, laboratories, and field trips. One laboratory course. *Wilbur*. Term I. 9:00–12:30. W58, 266

147L. Plant Ecology. Principles of the relationships between plants and their environments. Emphasis on structures and processes of coastal plain ecosystems. Not open to students who have had Botany 146L. Prerequisite: introductory

*See other courses listed under Botany and Zoology.

biology. (Given at Beaufort.) One and one-half courses. (6 units.) *Staff*. Term I. Footnotes: I, X. TBA

191. Independent Study. Directed reading and research. Open to qualified students in the junior and senior years by consent of department. Credit to be arranged. *Staff*. Terms I, III. Footnote: A. TBA

192. Independent Study. Directed reading and research. Open to qualified students in the junior and senior years by consent of department. Credit to be arranged. *Staff*. Term II. Footnote: A. TBA

204L. Marine Microbiology. The major groups of marine micro-organisms, their taxonomy, culture, physiology, and ecology. Prerequisite: a course in introductory biology or botany. (Given at Beaufort.) One and one-half courses. (6 units.) *Cavaliere*. Term III. Footnotes: I, X. TBA

211L. Marine Phycology. Introduction to marine algae, systematics, morphology, physiology, and ecology. Field trips, laboratory, and lectures. (Given at Beaufort.) One and one-half courses. (6 units.) *Searles*. Term II. Footnotes: I, X. TBA

216L. Photosynthetic Physiology of Marine Plants. Variations in photosynthetic mechanisms and their ecological consequences in seaweeds and seagrasses. Topics include light capture, carbon reduction pathways, carbon allocation, dark respiration, photorespiration, growth strategies, and competitive interaction. Analytical methodologies used in laboratory and field exercises. Prerequisites: introductory biology, organic chemistry, and physics; or consent of instructor. (Given at Beaufort.) One and one-half courses. (6 units.) *Ramus*. Term III. Footnotes: I, X. TBA

218L. Barrier Island Ecology. Adaptation of plants to barrier island migration and other physical characteristics of the coastal environment. Major emphasis will be placed on management of barrier beaches from Maine to Texas and the impact of human interference with natural processes. Field studies. Prerequisite: course in general ecology. (Given at Beaufort.) One and one-half courses. (6 units.) *Godfrey*. Term II. Footnotes: I, X. XREF: FES 218. TBA

225T. Special Problems. Students with adequate training may do special work in the fields listed below. Credit to be arranged. *Staff*. Terms II, III. Footnote: A. TBA

242L. Systematics. Principles of vascular plant taxonomy, with practice in identification of the local flora. Lectures, laboratories, and field trips. Prerequisite: one year of biology. One laboratory course. (4 units.) *Wilbur*. Term I. 9:00–12:30. W58, 266

247L. Plant Ecology. Principles of the relationships between plants and their environments. Emphasis on structures and processes of coastal plain ecosystems. Not open to students who have had Botany 246L. Prerequisite: introductory biology. (Given at Beaufort.) One and one-half courses. (6 units.) *Staff*. Term I. Footnotes: I, X. TBA

300. Tropical Biology: An Ecological Approach. Highly intensive, field-oriented course conducted in Costa Rica under auspices of the Organization for Tropical Studies. For additional information refer to Program Information in this bulletin. (8 units.) *Stone*. Term III. Footnote: S. TBA

359. Research in Botany. Individual investigation in the various fields of botany. Credit to be arranged. *Staff*. Terms I, III. TBA

360. Research in Botany. Individual investigation in the various fields of botany. Credit to be arranged. *Staff*. Term II. TBA

Chemistry (CHM)

Professor Krigbaum, *Chairman* (101 Gross Chemical Laboratory); Professor Jeffs, *Director of Graduate Studies* (329 Gross Chemical Laboratory); Professor Wilder, *Director of Undergraduate Studies* (328 Gross Chemical Laboratory)

11. Principles of Chemistry. The introductory course for students who intend to take any additional chemistry courses other than Chemistry 103. Chemistry 11 emphasizes stoichiometry and atomic and molecular structures. Laboratory work includes both qualitative and quantitative analysis. Prerequisites: one year of high school chemistry or consent of instructor and qualification for Mathematics 31. One laboratory course. *Wilder*. Term I. Footnote: E. 1:30–3:00. W65, 111. Lab daily except Tuesday. 9:00–12:00. W65, 201

12. Principles of Chemistry. The introductory course for students who intend to take any additional chemistry courses other than Chemistry 103. Chemistry 12 emphasizes thermodynamics, chemical kinetics, synthesis, and analysis. Laboratory work includes both qualitative and quantitative analysis. Prerequisites: one year of high school chemistry or consent of instructor and qualification for Mathematics 31. One laboratory course. *Anderson*. Term II. Footnote: E. 1:30–3:00. W65, 111. Lab daily except Tuesday. 9:00–12:00. W65, 201

151. Organic Chemistry. The structures and reactions of the compounds of carbon. Techniques of separation and structure determination. Prerequisite: Chemistry 12 or 42, or consent of the Director of Undergraduate Studies; Chemistry 151 or 151M is a prerequisite for 152. One laboratory course. *Leiby*. Term I. Footnote: E. 1:30–3:00. W65, 110. Lab daily except Tuesday. 9:00–12:00. W65, 225

152. Organic Chemistry. The structures and reactions of the compounds of carbons. Organic reactions and preparations. Prerequisite: Chemistry 151 or 151M is a prerequisite for 152. One laboratory course. *Ludt*. Term II. Footnote: E. 1:30–3:00. W65, 110. Lab daily except Tuesday. 9:00–12:00. W65, 225

161. Physical Chemistry. Fundamentals of theoretical chemistry illustrated by selected laboratory experiments. Prerequisites: Chemistry 152, Physics 52, and Mathematics 32. One laboratory course. *Smith*. Term I. Footnote: E. 1:30–3:00. W65, 104. Lab daily except Tuesday. 9:00–12:00. W65, 209

191. Independent Study. Supervised reading and research. Prerequisite: consent of the Director of Undergraduate Studies. One course. *Staff*. Terms I, II. Footnote: A. TBA

192. Independent Study. Supervised reading and research. Prerequisite: consent of the Director of Undergraduate Studies. One course. *Staff*. Term II. Footnote: A. TBA

213–214. Introductory Physical and Quantitative Chemistry: A Course for the AP Teacher. Intensive study of major topics covered in the AP chemistry course, including atomic and molecular structure, stoichiometry, elementary thermodynamics, chemical kinetics, electrochemistry, and physical chemistry of aqueous solutions. All day, five weeks, Monday through Friday. Lecture, laboratory, conferences. (6 units.) *Wilder*. Footnote: R. 19 June–21 July. 8:30–11:30; 1:00–4:00. W65, 103

Classical Studies

Professor Oates, *Chairman* (325 Carr Building); Professor Rigsby, *Director of Graduate Studies* (327 Carr Building); Professor Burian, *Director of Undergraduate Studies* (320 Carr Building)

CLASSICAL STUDIES (CS)

53. Greek History. The political and intellectual history of the Hellenes from earliest times to the death of Alexander the Great. One course. *Oates*. Term I. Footnote: C. XREF: HST 053. 11:40–1:10. W5, 219

137. The Roman Revolution. Rome from the time of the Gracchi to the death of Augustus (14 A.D.). One course. *Oates*. Term I. Footnote: C. XREF: HST 095. 9:50–11:20. W5, 219

GREEK (GRK)

181S.01 Greek Seminar. An intensive introduction to the language and literature. Prerequisite: proficiency in another language. Two courses. *Staff*. Term II. TBA

182S.01. Greek Seminar. An intensive introduction to the language and literature. Prerequisite: proficiency in another language. Two courses. *Staff*. Term III. TBA

191.01 Independent Study. Directed reading and research. (Open to highly qualified juniors and seniors.) One course. *Staff*. Term I. Footnotes: A,U. TBA

192.01. Independent Study. Directed reading and research. (Open only to qualified juniors and seniors.) One course. *Staff*. Term II. Footnotes: A,U. TBA

LATIN (LAT)

181S.01. Latin Seminar. An intensive introduction to the language and literature. Open only to students who have achieved proficiency in another language. Two courses. *Staff*. Term II. TBA

182S.01. Latin Seminar. An intensive introduction to the language and literature. Open only to students who have achieved proficiency in another language. Two courses. *Staff*. Term III. TBA

191.01. Independent Study. Directed reading and research. Open to qualified juniors and seniors. One course. *Staff*. Term I. Footnotes: A,U. TBA

192.01. Independent Study. Directed reading and research. Open to highly qualified juniors and seniors. One course. *Staff*. Term II. Footnotes: A,U. TBA

Computer Science (CPS)

Professor Patrick, *Chairman* (203 North Building); Professor Bierman, *Director of Graduate Studies* (203 North Building); Professor Gallie, *Director of Undergraduate Studies* (205 North Building)

51. Introduction to Digital Computation. Flow charts; an assembly language; program structures, subroutines, data structures, arrays, polynomials; an algorithmic language; numerical linear algebra, matrix inversion, linear programming, and least-squares techniques. One course. *Patrick*. Term I. 8:00–9:30. W56, 100

221. Numerical Analysis I. Error analysis and interval arithmetic, interpolation and polynomial approximation methods, numerical differentiation and integration, solution of simultaneous linear equations and matrix inversion, real and complex roots of nonlinear equations. Prerequisite: knowledge of an algorithmic programming language and intermediate calculus. (Also listed as Mathematics 221.) One course. *Patrick*. Term I. 9:50–11:20. W56, 100

Divinity School

Professor Langford, *Dean* (107B New Divinity School); Professor Lacy, *Associate Dean for Curricular Affairs* (101C New Divinity School)

NT 103. Hellenistic Greek. Designed for beginners to enable them to read the Greek New Testament. (Two terms: no credit will be given for 103 without completion of 104; however students with at least one full year of college Greek may be permitted to enroll in 104.) One course. *Efird.* Term I. 8:00–9:30. W7, 02

NT 104. Hellenistic Greek. (See NT 103 description.) One course. *Efird.* Term II. 8:00–9:30. W7, 02

399. By special arrangement with an instructor, a student may arrange for independent study in a given area of specialized research. Prerequisite: consent of instructor and the Associate Dean.

Drama (DRA)

Associate Professor Clum, *Director of the Duke University Drama Program* (317 Carr Building, East Campus)

107S. Advanced Scene Study. Study of research on historical, psychological, and technical interpretation for actors. Prerequisite: Drama 101 and 102. One course. *Guest artist and Clum.* Term I. Footnote: A. 1:30–3:30. ED, 209

109. Television Workshop. Acting and directing for television. Led by guest artist to be announced. One course. (Lab fee—not collected by summer session office.) Instructor's permission. *Guest and Clum.* Term II. Footnote: A, J. 1:30–4:00. ED, 209

156. Jarry to Beckett: The New French Theatre. A Study of trends in twentieth-century French drama and theatre focusing on leading directors and playwrights. One course. *Fowlie.* Term II. 9:50–11:20. W10, 124

181S. Conference on Special Topics: Drama Criticism. Readings from Aristotle to the present. The writing of drama criticism and drama reviews. One course. *Reardon.* Term I. Footnote: C. XREF: ENG 181S. 9:50–11:20. W53, 315

189. The American Film. A survey history focusing on the work of major directors. One course. Screenings to be arranged. Lab fee. *Schwartz and Clum.* Term I. Footnotes: J, C. XREF: ENG 89. 11:40–1:10. W10, 136

191.01. Independent Study: Design Apprenticeship. One course. *Regier and Wetzel.* Term I. Footnote: A. TBA

192.01. Independent Study: Design Apprenticeship. One course. *Regier and Wetzel.* Term II. Footnote: A. TBA

193.01. Independent Study: Design Apprenticeship. One course. *Regier and Wetzel.* Term I. Footnote: A. TBA

194.01. Independent Study: Design Apprenticeship. One course. *Regier and Wetzel.* Term II. Footnote: A. TBA

Economics (ECO)

Professor Blackburn, *Acting Chairman* (215–A Social Sciences Building); Professor Weintraub, *Director of Graduate Studies* (315 Social Sciences Building); Professor Davies, *Director of Undergraduate Studies* (302 Social Sciences Building)

51. National Income and Public Policy. Basic economic analysis emphasizing current public policy issues. How the level and rate of growth of aggregate national income and output are determined. What causes unemployment, inflation, and international payment problems. How monetary policy (money supply and interest rates) and fiscal policy (government expenditures and taxes) affect these problems. One course. *Yohe*. Term II. 8:00–9:30. W10, 213

52. Competition, Monopoly, and Welfare. A continuation of Economics 51. How the composition of the economy's output and distribution of its income (who is rich and who is poor) are determined in a market economy by supply and demand. How and why markets work or fail to work and the implications of social policies. Role of government in a market economy. Contemporary problems of the environment. Topics such as environmental economics, monopoly, unionism, international trade. Comparison of a market economy with other systems of economic organization. Economic problems of developing countries. One course. *Bolnick*. Term I. 8:00–9:30. W10, 213

53. Economics of Contemporary Issues. Modern economic problems, such as environmental deterioration and urban decay. The market as one of the interrelated subsystems of the social system, from institutionalist, Marxist, and other perspectives in the social sciences. One course. *Havrilesky*. Term II. 11:40–1:10. W10, 231

108. Economics of War. Conflict theory, causes and economic consequences of war, military manpower, military-industrial complex, disarmament, and the economy. Prerequisite: Economics 52. One course. *Weintraub*. Term I. 8:00–9:30. W10, 231

149. Microeconomic Theory. Cost and supply considerations in price theory; the demand for factors of production. The allocation of resources is examined in the context of competitive and monopolistic market structures. Prerequisites: Mathematics 51 and Economics 2 or 52. (Not open to students who have had either Economics 161 or Public Policy Studies 110.) One course. *Yohe*. Term II. 9:50–11:20. W10, 213

153. Monetary Economics. The evolution and operations of commercial and central banking and nonbanking financial institutions in the United States, the determination of monetary aggregates and interest rates, the financial impacts of Treasury operations, and the linkages from Federal Reserve actions to price level, employment, economic growth, and balance of payments objectives. One course. *Havrilesky*. Term II. 8:00–9:30. W10, 231

154. Aggregate Economics. Concepts and measurement of national income and expenditures, employment, interest rates, and price levels; the theoretical determination of these aggregates; applications of macroeconomic theory to business cycles and economic growth. Prerequisites: Economics 51 and Mathematics 31. One course. *Weintraub*. Term I. 11:40–1:10. W10, 231

Education (EDU)

Professor Flowers, *Chairman* (211 West Duke Building); Professor Pittillo (213–I West Duke Building); Professor Carbone, *Director of Graduate Studies* (213–H West Duke Building); Professor Colver, *Director of Undergraduate Studies* (205 West Duke Building); Professor Cartwright, *Director of MAT Program* (213–A West Duke Building)

100. Social and Philosophical Foundations of Education. Basic features and assumptions, viewpoints, and issues of education in contemporary America. One course. *Di Bona*. Term I. 8:00–9:30. EA, 202

205.37. Writing Project Institute. Credit to be arranged. *Michlin*. Term II. TBA

205.42. Group Dynamics. One course. (3 units.) *Newton*. Term I. 9:50–11:20. EA, 202

205.43 Crisis Theory and Intervention. One course. (3 units.) *Pinkerton*. Term III. 9:50–11:20. EA, 08A

210. The Politics of Education. One course. (3 units.) *Leach*. Term II. Footnote: C. XREF: PS 210. 11:40–1:10. W4, 301

217. The Psychological Principles of Education. Advanced study of teaching, learning, and the learner. One course. (3 units.) *Staff*. Term III. 8:00–9:30. EA, 08A

223. Teaching the Language Arts. Comparison of current methods and materials in the teaching of handwriting, spelling, and oral and written composition. Analysis and correction of basic difficulties. One course. (3 units.) *Adams*. Term III. 11:40–1:10. EA, 202

224. Teaching the Social Studies in Elementary Schools. One course. (3 units.) *Cartwright*. Term II. Tuesday and Thursday. 6:30–9:45 P.M. EA, 202

225. The Teaching of History and the Social Studies. Evaluation of the objectives, content, materials, and methods in the teaching of history and the social studies. One course. (3 units.) *Cartwright*. Term II. Tuesday and Thursday. 6:30–9:45 P.M. EA, 202

232. Psycho-educational Counseling with Parents. Individual and group counseling concerning psychoeducational problems of parents and children. Prerequisite: consent of instructor. One course. (3 units.) *Ballantyne*. Term I. 8:00–9:30. EA, 08A

234. Secondary School Organization and Administration. Objectives and philosophy underlying the organization and administration of the secondary school. One course. (3 units.) *Flowers*. Term II. 8:00–9:50. EA, 202

236. Teaching Developmental and Remedial Reading in the Secondary School. Principles, methods, and materials for the development of effective reading attitudes and skills in developmental and remedial programs. One course. (3 units.) *Adams*. Term III. 8:00–9:30. EA, 202

239. Teaching of Grammar, Composition, Mechanics, and Usage in Secondary School. Recent developments. One course. (3 units.) *Michlin*. Term II. Monday and Wednesday. 6:30–9:45 P.M. EA, 202

243. Personality Dynamics. Personality structure and dynamics emphasizing implications for counseling and instruction. Prerequisite: six hours of psychology or educational psychology. One course. (3 units.) *Gehman*. Term II 8:00–9:30. EA, 08A

244. Counseling Techniques. Individual counseling techniques; diagnosis, interviewing, program planning, and counseling evaluation. Prerequisites: Education 243 and 258 or equivalent, which may be taken concurrently. One course. (3 units.) *Gehman*. Term II. 1:30–3:00. EA, 08A

246. Teaching of Mathematics. Aims, curriculum, and classroom procedure for teaching secondary school mathematics. One course. (3 units.) *Kuhn*. Term II. 3:20–4:50. EA, 202

247. Practicum in Guidance and Counseling. Local field experience in counseling and guidance program. Minimum of 150 hours of case work and supervision. Prerequisite: consent of instructor. One course. (3 units.) May be repeated. *Staff*. Terms I, II. TBA

248. Practicum in Counseling. Individual counseling; test administration, intake interviewing, diagnosis, program planning, report preparation, and evaluation. Minimum of 150 hours of case work and conferences with the supervisor. Prerequisite: consent of instructor. One course. (3 units.) May be repeated. *Staff*. Terms I, II, III. TBA

249. Exceptional Children. Survey of major categories of exceptional children: mentally retarded, emotionally disturbed, brain injured, learning disabled, physically handicapped, visual and auditory deficient, culturally deprived, and gifted. Etiology (biological and environmental factors), diagnosis, and treatment. One course. (3 units.) *Davis*. Term II. 11:40–1:10. EA, 202

253. Introduction to Law and Education. Basic elements of legal research, with primary emphasis on concepts and procedures relevant to educational problems. Analysis of selected cases. One course. (3 units.) *Martin*. Term II. 1:30–3:00. W4, 027

276. The Teaching of High School Science. Discussion, lectures, and collateral reading related to such topics as aims, tests, curriculum, classroom and laboratory procedure, field trips, and course and lesson planning for secondary-school science. One course. (3 units.) *Kuhn*. Term II. 1:30–3:00 EA, 202

287, 288. Physical Science for Teachers, I and II. Study of the major topics of introductory physics (I) and chemistry (II) with emphasis on laboratory work suitable for grades nine through twelve. Lecture and laboratory. (3 units per course.) *Githens*. 19 June–21 July. 8:30–11:30, 1:00–4:00. W65, 104

303. Diagnostic and Educational Programs in Learning Disabilities. Diagnostic, intervention, and remediation strategies and program development for the child with learning disabilities; review of major works in this field. Prerequisite: consent of instructor. 3 units. *Davis*. Term II. 9:50–11:20. EA, 202

311. Group Counseling. Theories and techniques of counseling for small groups of children, adolescents, teachers, parents, and other adults. Prerequisite: consent of instructor. (3 units.) *Ballantyne*. Term I. 11:40–1:10. EA, 202

315. Seminar in Secondary School Teaching. Advanced-level consideration of principles, practices, and problems in secondary school instruction. Designed particularly to accompany an internship. For students without previous internship credit. 3 units. *Carbone*. Term II. Footnote: S. 9:00–1:45. TBA

323. Public School Finance. Educational costs, sources of revenue for the support of public education, collection of revenue, basis of distribution, and accounting for funds spent. (3 units.) *Pittillo*. Term II. 9:50–11:20. EA, 204

350. Directed Activities in Education. Internship experiences at an advanced level under supervision of appropriate staff. Consent of instructor. (3 units.) *Staff*. Terms I, II, III. TBA

351. Directed Activities in Education. Internship experiences at an advanced level under supervision of appropriate staff. Consent of instructor. (3 units.) *Staff*. Terms I, II, III. TBA

Engineering

Professor Vesić, *Dean of the School of Engineering* (136 Engineering Building); Professor Shepard, *Associate Dean of the School of Engineering* (136 Engineering)

ENGINEERING (INTERDEPARTMENTAL) (EGR)

11. Engineering Graphics. Graphical theory and techniques for engineering design and communication. Visualization and conventional representation of points, lines, surfaces, and objects using freehand sketches. Orthographic (including sectional and auxiliary), perspective, isometric, and oblique views. Introduction to working drawings. Elements of descriptive geometry, and graphic mathematics. Half-course. *Arges*. Term II. Tuesday and Friday. 9:50–11:20. W47, 209

51. Computers in Engineering. Introduction to use of digital computers in engineering. Attributes of digital computer systems; program languages, flow charts; numerical analysis, including approximation and interpolation, searches and maximization, linear equations; applications to engineering; introduction to decision processes in engineering, including linear programming, optimization network methods; punched card operation; graphical output. (Not open to students who have completed Computer Science 51.) One laboratory course. *Ulku*. Term II. 11:40–1:10. Laboratory, Tuesday and Thursday. 3:15–5:00. W47, 218

72. Introduction to Systems Dynamics. Unified treatment of mechanical, electrical, fluid, and thermal dynamic systems. Formulation and solution of differential equations; operators, transfer functions, and complex variables. Energy concepts for multiport system analysis. Simulation and analog solution of a variety of engineering problems. Prerequisites: Physics 51 and Mathematics 32. One laboratory course. *Wright*. Term I. Footnote: R. 9:50–11:20. W47, 208

83. Structure and Properties of Solids. An introduction to materials science and engineering, emphasizing the relationships between the structure of a solid and its properties. The atomic and molecular origins of electrical, mechanical, and chemical behavior are treated in some detail for metals, alloys, polymers, ceramics, glasses, and composite materials. Prerequisites: Chemistry 11 and Mathematics 31. One laboratory course. *Shepard*. Term I. Footnotes: P,R. 8:00–9:30. W47, 208

101. Thermodynamics. A rigorous development of engineering thermodynamics emphasizing the logical structure and manipulation. Classical and statistical concepts of the laws of thermodynamics. Energy and entropy analyses of thermodynamic systems. Property relationships. Chemically reactive systems. Application to power production and energy conversion. Prerequisites: Physics 51 and Mathematics 103. One course. *Elsevier*. Term I. 9:50–11:20. W47, 207

BIOMEDICAL ENGINEERING (BME)

Professor Pilkington, *Chairman and Director of Undergraduate Studies* (263 Engineering Building); Professor Thurstone, *Director of Graduate Studies* (266 Engineering Building)

191. Projects in Biomedical Engineering. This course is available to seniors who express a desire for such work and who have shown aptitude for research in one area of biomedical engineering. Half-course to two courses. *Staff*. Terms I, II, III. Footnote: A. TBA

192. Projects in Biomedical Engineering. This course is available to seniors who express a desire for such work and who have shown aptitude for research in

one area of biomedical engineering. Half-course to two courses. *Staff*. Terms I, II, III. Footnote: A. TBA

221. Electrophysiological Techniques. Instruction in and practice with contemporary methods in electrophysiology with emphasis on intracellular recording and stimulating techniques. Topics include fabrication and use of microelectrodes, electronic instrumentation, voltage clamping, microiontophoretic techniques, as well as bioelectric data processing and modeling. Format will include lectures and demonstrations, but the main effort will be devoted to practicum work in the laboratory. Prerequisites: Biomedical Engineering 101 or Physiology 225 or permission of instructor. One laboratory course. (4 units.) *Wachtel and staff*. Term I. Footnote: C. XREF: PHS 221. TBA.

CIVIL ENGINEERING (CE)

Professor Melosh, *Chairman* (136 Engineering Building); Professor Dvorak, *Director of Graduate Studies* (126 Engineering Building); Professor Brown, *Director of Undergraduate Studies* (120 Engineering Building)

16. Surveying for Engineers. The theory and application of measurements required for planning, design, and construction of engineered facilities. Transit-tape and stadia surveys; differential and profile leveling; traverse computations; topographic mapping. Laboratory included. Prerequisite: Mathematics 19. Corequisite: Mathematics 31. Half-course. *Arges*. Term II. Monday, Wednesday, Thursday. 8:00–11:20. W47, 201

197. Projects in Civil Engineering. This course may be taken by junior and senior engineering students who have demonstrated aptitude for independent work. Prerequisites: consent of the instructor and the Director of Undergraduate Studies. Half-course or one course. *Staff*. Terms I, II, III. Footnote: A. TBA

198. Projects in Civil Engineering. This course may be taken by junior and senior engineering students who have demonstrated aptitude for independent work. Prerequisites: consent of the instructor and the Director of Undergraduate Studies. Half-course or one course. *Staff*. Terms I, II, III. Footnote: A. TBA

ELECTRICAL ENGINEERING (EE)

Professor Hacker, *Chairman* (128 Engineering Building); Professor Marinos, *Director of Graduate Studies* (173 Engineering Building); Professor Joines, *Director of Undergraduate Studies* (175 Engineering Building)

113. Introductory System Theory. Fourier series. Fourier and Laplace transforms; transfer function analysis. Impulse functions; impulse response of systems; convolution and time domain analysis. Discrete time models and computer simulation of continuous systems. Multiple input-output systems; introduction to state variable analysis. Prerequisite: Electrical Engineering 63. One course. *Kerr*. Term I. TBA. W47, 115

155.01. Special Topics in Electrical Engineering. Study of selected topics in electrical engineering tailored to fit the requirements of a small group. Prerequisites: consent of Director of Undergraduate Studies and instructor. Half-course or one course. *Staff*. Terms I, II. Footnote: A. TBA

156.01. Special Topics in Electrical Engineering. Study of selected topics in electrical engineering tailored to fit the requirements of a small group. Prerequisites: consent of the Director of Undergraduate Studies and the instructor. Half-course or one course. *Staff*. Terms I, II. Footnote: A,S. TBA

155.02. Special Topics in Electrical Engineering. Study of selected topics in electrical engineering tailored to fit the requirements of a small group. Prerequisites: consent of the Director of Undergraduate Studies and the instructor. One course. *Artley*. Term I. Footnotes: A,S. TBA

156.02. Special Topics in Electrical Engineering. Study of selected topics in electrical engineering tailored to fit the requirements of a small group. Prerequisites: consent of the Director of Undergraduate Studies and the instructor. One course. *Artley*. Term I. Footnotes: A,S. TBA

265. Advanced Topics in Electrical Engineering. Opportunity for study of advanced subjects related to programs within the electrical engineering department tailored to fit the requirements of a small group. Prerequisites: approval of the Director of Undergraduate Studies and of instructor under whom work will be done. One course. (3 units.) *Staff*. Terms I, II. TBA

399. Special Readings. *Staff*. Terms I, II. Footnote: A. TBA

MECHANICAL ENGINEERING AND MATERIALS SCIENCE (ME)

Professor Chaddock, *Chairman* (142A Engineering Building); Professor Cocks, *Director of Graduate Studies* (190 Engineering Building); Professor Garg, *Director of Undergraduate Studies* (185 Engineering Building)

165. Special Topics in Mechanical Engineering. Study arranged on a special engineering topic in which the faculty has particular interest and competence as a result of research and professional activities. Prerequisites: consent of the instructor and the Director of Undergraduate Studies. Half-course or one course. *Staff*. Terms I, II, III. Footnote: A. TBA

198. Projects in Mechanical Engineering. This course may be assigned by the chairman of the department to outstanding seniors who express a desire for such work and who have shown aptitude for research in one distinct field of mechanical engineering. Prerequisites: *B* average and senior standing. Half-course to two courses. *Staff*. Terms I, II, III. Footnote: A. TBA

265. Advanced Topics in Mechanical Engineering. Opportunity for study of advanced subjects related to programs within mechanical engineering tailored to fit the requirements of a small group. Prerequisites: approval of the Director of Undergraduate or Graduate Studies and the instructor under whom work will be done. Variable credit. *Staff*. Terms I, II, III. Footnote: A. TBA

399. Special Readings in Mechanical Engineering. *Staff*. Terms I, II, III. TBA

English (ENG)

Professor Budd, *Chairman* (325 Allen Building); Professor Nygard, *Director of Graduate Studies* (315 Allen Building); Professor Butters, *Director of Undergraduate Studies* (322 Allen Building)

Candidates for the master's degree in English are expected to have had at least 18 units in undergraduate courses above the sophomore level. The department may also require additional courses if the work of the student in the first term indicates inadequate preparation. Courses with *S* suffix limited to fifteen students.

21S.01. Studies in the Novel: Some Offbeat Private Lives in Twentieth-Century Fiction. The list of readings, including Lawrence's *Lady Chatterley's Lover*, Forster's *Maurice*, and Jean Rhys's *Quartet*, will comprise works dealing with special emotional dilemmas. One course. *Smith*. Term III. 9:50–11:20. W53, 315

26S.10. Studies in Modern Fiction. Selected short stories and novels by contemporary authors. Will include John Barth, Vladimir Nabokov, John Fowles, Thomas Pynchon, Saul Bellow, John Updike. One course. *DeNeef*. Term I. 9:50–11:20. W53, 328

26S.20. The Literature of Fantasy. Analysis of themes, forms, and sources of representative works of fantasy with emphasis on twentieth-century examples. One course. *Monsman*. Term II. 1:30–3:00. W53, 328

55. Representative British Writers. Selections from Chaucer, Shakespeare, Donne, and Milton. One course. *Ferguson*. Term II. 1:30–3:00. W53, 318

56S. Representative British Writers. Selections from Pope, Wordsworth, Keats, Browning, and Yeats. One course. *Strandberg*. Term I. 11:40–1:10. W53, 315

57S. Representative American Writers. Selections and complete works. Poe, Emerson or Thoreau, Hawthorne, Melville, Whitman, Dickinson, and Twain. Prospective majors should take courses numbered 161–162, 171–172, instead of this course. One course. *Williams, K.* Term II. 11:40–1:10. W53, 215

58S. Representative American Writers. Selections and complete works of James, Frost or Robinson, Crane or Dreiser, O'Neill, Faulkner, Hemingway, and others. Prospective majors should take courses numbered 161–162, 171–172 instead of this course. One course. *Jones*. Term III. 11:40–1:10. W53, 328

65S. Imaginative Writing. Informal essay, short story, poetry, drama, and film. Prerequisite: consent of instructor. One course. *Monsman*. Term II. 11:40–1:10. W53, 328

89. The American Film. A survey history focusing on the work of major directors. One course. Screenings to be arranged. Lab fee. *Clum and Schwartz*. Term I. Footnotes: J,C. XREF: DRA 189. 11:40–1:10. W10, 136

163. Studies in a Major American Author. Readings in the works of such writers as Faulkner, Hawthorne, James, or Whitman. One course. *Strandberg*. Term I. 8:00–9:30. W53, 318

181S. Conference on Special Topics: Drama Criticism. Readings from Aristotle to the present. The writing of drama criticism and drama reviews. One course. *Reardon*. Term I. Footnote: C. XREF: DRA 181S. 9:50–11:20. W53, 315

209. Present-Day English. A description of present-day American English from the point of view of modern linguistic theory; comparison of traditional and structural grammars; semantic change; the relation of the written to the spoken language; usage. One course. (3 units.) *Nygard*. Term III. 9:50–11:20 W53, 318

221. English Prose and Poetry of the Sixteenth Century. Readings in the major nondramatic forms and authors from Sir Thomas More to John Donne, excluding Spenser's *Faerie Queene*. One course. (3 units.) *DeNeef*. Term I. 8:00–9:30. W53, 315

251. English Literature of the Twentieth Century. Representative work of leading writers from 1900 to 1950, in fiction, drama, and poetry. Shaw, Conrad, Yeats, Wells, Bennett, Galsworthy, Ford, Synge, Forster, and Lawrence. One course. (3 units.) *Smith*. Term III. 8:00–9:30. W53, 318

280. Introduction to Folklore. A survey of the materials of popular tradition, the folksong, the folktale, the proverb, the riddle, and other forms; the methods of folklore investigation; and the relation of these popular genres to literary tradition. One course. (3 units.) *Nygard*. Term III. 11:40–1:10. W53, 318

287. Theory of Literature from Kant to the Present. A survey of literary theory: intellectual currents of Romanticism, the classic revival, the realistic schools, symbolism, the recent analytic schools. One course. (3 units.) *Duffey*. Term II. 9:50–11:20. W53, 326

291. Augustan to Romantic: Myth and the Revolutionary Poetics of Displacement. One course. (3 units.) *Jackson*. Footnote: W. 18 June–10 August. 9:50–10:50. W53, 327

362. Studies in a Major American Author of the Later Nineteenth Century. Dreiser. (3 units.) *Williams, K.* Term II. 8:00–9:30. W53, 315

Forestry and Environmental Studies (FES)

Professor Jayne, *Dean of the School of Forestry and Environmental Studies* (216 Biological Sciences Building); Professor Barnes, *Director of Graduate Studies* (309 Biological Sciences Building)

The requirements for the degree of Master of Forestry (M.F.) and Master of Environmental Management (M.E.M.) are governed by the extent of the student's previous undergraduate education and by specific career objectives. All students, except those who have already had equivalent work, begin their programs with a four-week session in August which includes a modular course appropriate for both the M.F. and M.E.M. programs. Topics in identification of flora and fauna, population parameters, sampling, data analysis, and environmental quality determinations are included. Some modules emphasize intensive study of a particular ecosystem; others are concerned with environmental and resource measurements. The modular course offers the opportunity to acquire specific professional skills which are not taught in regular courses.

Qualified students may engage in thesis or project research in certain branches of forestry and environmental studies during the summer session with the approval of the Instructor concerned and the Dean of the School of Forestry and Environmental Studies, or of the Director of Graduate Studies in the case of work taken through the Graduate School.

191. Independent Study. Variable credit. *Staff*. Terms I, II, III. Footnote: A. TBA

218.01. Barrier Island Ecology. One and one-half courses. (6 units.) *Godfrey*. Term II. Footnotes: C,IX. XREF: BOT 218L. TBA

291. Modules in Ecosystem Analysis. Introduction to methods of characterizing ecosystems, with special reference to identification, measurement, and mapping of vegetation, soil, water, and animal resources. Emphasis on field work. (4 units.) *Barnes*. Footnotes: E,L. 30 July–24 August. 8:00–4:00. W58, 202

299. Independent Projects. Directed readings, research, or practical work at the graduate level to meet the needs of individual students in the following areas. Units and times to be arranged unless otherwise noted. Terms I, II, III. Sections:

1. **Dendrology.** *White*
2. **Ecology.** *Richardson, Thompson*
3. **Entomology.** *Anderson*
4. **Environmental Design.** *Staff*
5. **Environmental Education.** *Rajagopal*
6. **Environmental Policy and Values.** *Convery*

7. **Environmental Systems Analysis.** *Staff*
8. **Forest Management.** *Staff*
9. **Mensuration and Biometry.** *Yandle*
10. **Meteorology and Hydrology.** *Knoerr*
11. **Operations Research.** *Rajagopal*
12. **Forest Pathology.** *Stambaugh*
13. **Physiology and Biochemistry.** *Barnes, Hellmer*
14. **Plant Anatomy.** *Philpott*
15. **Propagation of Woody Plants.** *Philpott*
16. **Resource Economics.** *Convery*
17. **Resource Planning.** *Staff*
18. **Resource Management.** *Staff*
19. **Silviculture.** *White*
20. **Soils.** *Ralston*
- 399.01. **Master's Project.** *Staff*

Geology (GEO)

Professor Perkins, *Chairman* (119 Science Building, East Campus); Professor Heron, *Director of Graduate Studies* (119 Science Building, East Campus); Professor Lynts, *Director of Undergraduate Studies* (104 Science Building, East Campus)

3. Environmental Geology. Earth processes and materials, as related to man. Lectures, field trip, and eight hours of mini-lab. Not open to those who have completed Geology 1. One course. *Heron*. Term I. 11:40–1:10. EC, 116. *Heron*. Term II. 1:30–3:00. EC, 116

192. Independent Study. Directed reading and research. Open only to qualified juniors and seniors by permission of the Director of Undergraduate Studies. One course. *Staff*. Term II. Footnote: A. TBA

205. Geological Oceanography. Broad geological aspects of the ocean basins including origin, bottom physiography, sediment distribution, submarine sedimentary processes and shoreline processes. Field observations. Sampling procedures. Not open to students who have completed Geology 206S. (Given at Beaufort.) One and one-half courses. (6 units.) *Glaeser and Pilkey*. Term II. Footnotes: I,X. TBA

250. Introduction to Marine Geophysics. Topics include seismic reflection and refraction, magnetics, gravity, and seismology. Prerequisite: Introductory physics or consent of instructor. (Given at Beaufort.) One and one-half courses. (6 units.) *Rosendahl*. Term III. Footnotes: I,X. TBA

German (GER)

Professor Phelps, *Chairman* (106 Languages Building); Professor Rolleston, *Director of Graduate Studies* (105 Languages Building); Professor Bessent, *Director of Undergraduate Studies* (107 Languages Building)

1. Elementary German. Practice in understanding, speaking, reading, and writing. Classroom techniques are combined with those of the language laboratory. One laboratory course. *Alt.* Term I. Footnotes: E,T,R. Monday, Wednesday, and Thursday. 11:40–1:10. Tuesday and Friday. 2:00–3:20. W5, 109

2. Elementary German. Practice in understanding, speaking, reading, and writing. Classroom techniques are combined with those of the language laboratory. One laboratory course. *Staff.* Term II. Footnotes: E,T,R. Monday, Wednesday, and Thursday. 11:40–1:10. Tuesday and Friday. 2:00–3:20. W5, 109

63.01. Intermediate German. Prerequisite: German 1–2 or equivalent. One laboratory course. *Staff.* Term II. Footnotes: E,T,R. 9:50–11:20. W5, 109

181. German for Reading, I. Foundations of German grammar and syntax; emphasis on vocabulary and complex verbal structures. Not open for credit to students who have completed German 1 and 2 or the equivalent. One course. *Alt.* Term I. Footnote: T. 9:50–11:20. W5, 109

191. Independent Study. Directed reading and research. Open only to qualified students in the junior year, by consent of the department. One course. *Staff.* Term II. Footnote: A. TBA

192. Independent Study. Directed reading and research. Open only to qualified students in the junior year by consent of the department. One course. *Staff.* Term II. Footnote: A. TBA

193. Independent Study. Directed reading and research. Open only to qualified students in the senior year, by consent of the department. One course. *Alt.* Term I. Footnote: A. TBA

194. Independent Study. Directed reading and research. Open only to qualified students in the senior year, by consent of the department. One course. *Staff.* Term II. Footnote: A. TBA

399. Special Readings. *Staff.* Term II. Footnote: A. TBA

The Duke-Vassar Summer Program in Münster, Germany

Students can earn up to two courses for work taken in Münster: German 117 and 118 (Conversation) or one conversation course and German 127 (Contemporary German) or German 130 (German Life and Thought). No student may receive credit for both 127 and 130. For detailed information on the program, contact Professor Helga Bessent, Department of German, Duke University, Durham, North Carolina 27706.

63.02. Intermediate German. Prerequisite: German 1–2 or equivalent. *Klabes.* Footnotes: A,O,T. 23 May–4 July. TBA

117S.02. German Conversation and Composition. Primarily conversation with oral and written reports, based on works by contemporary writers of East and West Germany. Required for German majors and other students by consent of instructor. One course. *Klabes.* Footnotes: O,A. 23 May–4 July. TBA

118S.02. German Conversation and Composition. Primarily conversation with oral and written reports, based on works by contemporary writers of East and West Germany. Required for German majors and other students by consent of instructor. One course. *Bessent.* Footnotes: A,O. 23 May–4 July. TBA

127.02. Contemporary Germany. The current literary scene in the two Germanies in its cultural, social, and political contexts. One course. *Bessent.* Footnotes: A,O. 23 May–4 July. TBA

130.02. German Life and Thought. German cultural and intellectual history. Reading and discussion in English. One course. *Klabes and team*. Footnotes: A,O. 23 May–4 July. TBA

Health Administration (HA)

Professor Jaeger, *Chairman* (114A Trent Hall); Professor Smith, *Director of Graduate Studies* (114D Trent Hall)

All courses extend throughout the summer session and are ordinarily closed to students in departments other than health administration.

313. Quantitative Decision Making. The development of a quantitative modeling framework derived from the concepts of the systems approach to analyze management decisions in health administration. The focus of the course is on the knowledge and skills needed to manage the analysis (i.e., formulation, assumptions, interpretation, cost of analysis) rather than on performing the analysis, emphasizing the process of analysis over detail of techniques. Decisions are analyzed both deterministically and stochastically, and on a scale from simple to complex. Techniques that serve the framework include calculus, inventory theory, PERT, decision analysis, fixed vs. variable cost analysis, queueing, simulation, and mathematical programming. Examples from the field are used extensively. The latter part of the course presents the concepts of quantitative control, with the same emphasis and again with examples from the field. (4 units.) *Warner*. 8 May–17 August. TBA

326. Health Economics. A study of the current state of knowledge with regard to the economics of health and medical care. Attention is given to the unique problems of demand and supply in the health services sector, as well as the implications of private and public financing alternatives; restrictions on manpower entry; incentive mobility; and problems of productivity measurement and change. (2 units.) *Cummins*. 8 May–17 August. TBA

333. Health Finance. Application of the principles of financial and managerial accounting to the health environment. Discussion of influences of reimbursement, mechanisms of rate setting, applications of budgeting principles, and working capital management. (4 units.) *Delaney*. 8 May–17 August. TBA

340. Social Dimensions of Illness. Introduction to basic principles of epidemiology, discussion of major health problems as they affect individuals, families, populations, and the health system, and consideration of the applications of epidemiological concepts to the evaluation and planning of health organizations and systems. (3 units.) *Smith*. 8 May–17 August. TBA

351. Institutional Health Services. A broad examination of the provision of health services in institutional settings. The principal focus is on the general hospital, but attention is also given to the mental hospital and other long-term care institutions. Specific study utilizing lectures and cases is made of the administrative and informational organization; the structure and function of each department; relationships between administration and the governing board, the medical staff, and the community; operational and capital financing; the planning function; and the evaluation of performance. (3 units.) *Staff*. 8 May–17 August. TBA

371. Directed Research. Individual studies by arrangement. (3 units.) *Staff*. 8 May–17 August. TBA

Health, Physical Education, and Recreation (PE)

Professor Friedrich, *Chairman* (105-A Card Gym); Professor Skinner, *Director of Undergraduate Instruction* (106 Card Gym)

15. Individual Development: Aerobics, Weight Training, Conditioning. A planned program of progressive, cumulative, and measurable physical activities adapted to individual needs. Designed to increase fitness. Half-course. *Riebel*. Term I. Footnotes: L,T. 8:00-9:30. W17. *Buehler*. Term II. Footnotes: L,T. TBA. W17

20. Beginning Swimming. Techniques for water safety: breathing control, floating, and elementary swimming. Half-course. *Staff*. Term I. Footnotes: L,T. 11:40-1:10. W17

21. Intermediate Swimming Stroke techniques and diving. Resuscitation. Prerequisite: Physical Education 20 or the equivalent. Half-course. *Staff*. Term II. Footnotes: L,T. 8:00-9:30. W47

23. Beginning Kayaking. Development of all phases of single kayaking. Lake and river experience provided. (Additional fee: \$45 not collected by summer session office.) Half-course. *Harvey*. Term II. Footnotes: J,L,T. TBA

25. Water Safety Instructors Course: New Materials of American Red Cross. Red Cross Water Safety Instructors Certificate upon satisfactory completion. Prerequisite: Physical Education 24 or equivalent. Half-course. *Staff*. Term II. Footnotes: L,T. 9:50-11:20. W17

30. Beginning Golf. Fee. Half-course. *Myers*. Term I. Footnotes: J,L,T. 9:50-11:20. W17

32. Handball, Racquetball, Squash. No previous experience necessary. Half-course. *Skinner*. Terms I, II, III. Footnotes: L,T. 11:40-1:10. W75

41. Intermediate Tennis. Introduction to volley, lob, and smash. Competition in singles and doubles. Prerequisite: Physical Education 40 or equivalent. Half-course. *Staff*. Term I. Footnotes: L,T. 9:50-11:20. W17. *LeBar*. Term II. Footnotes: L,T. 8:00-9:30. W17

92. Cardiopulmonary Resuscitation. The techniques of artificial respiration and artificial circulation. Half-course. *Staff*. Term I. Footnotes: L,T. TBA. W17

136S.01 Personal Health. Fitness and fatigue. One course. *Friedrich*. Term I. 9:50-11:20. W17, 104

163. Coaching Baseball and Track in Secondary Schools. Theory and practice. Open to juniors and seniors. One course. *Buehler*. Term II. 8:00-9:30. W17, 104

172. The Administration of Physical Education and Athletics in Secondary Schools. Emphasis on leadership concepts is given through case studies, field trips, and appraisal of various types of programs. Open to juniors and seniors. One course. *Friedrich*. Term II. 11:40-1:10. W17, 104

173. Protective Practices in Physical Education. Safety and protective measures, including training and rehabilitation. Open to juniors and seniors. One course. *Grossman*. Term I. 8:00-9:30. W17

Dance

62. Intermediate Modern Dance I Movement and expression. Prerequisite: Physical Education 61. Half-course. *Blumfeld*. Term I. Footnotes: L,T. 1:30-3:00. E1

American Dance Festival (16 June-28 July)

Martha Myers, *Dean of the American Dance Festival* (104-A West Duke Building)

For description of program, see the section, Program Information, in this bulletin.

Dance Techniques

101. 201. Modern Dance Technique: Elementary. Quarter-course. (1 unit.)
Staff

102. 202. Modern Dance Technique: Intermediate. Quarter-course. (1 unit.)
Staff

103. 203. Modern Dance Technique: Intermediate/Advanced. Quarter-course. (1 unit.) *Staff*

104. 204. Modern Dance Technique: Advanced. Quarter-course. (1 unit.)
Staff

111. 211. Jazz Technique: Elementary. Quarter-course. (1 unit.) *Staff*

112. 212. Jazz Technique: Intermediate. Quarter-course. (1 unit.) *Staff*

113. 213. Jazz Technique: Advanced. Quarter-course. (1 unit.) *Staff*

121. 221. Ballet Technique: Elementary. Quarter-course. (1 unit.) *Staff*

122. 222. Ballet Technique: Intermediate. Quarter-course. (1 unit.) *Staff*

123. 223. Ballet Technique: Intermediate/Advanced. Quarter-course. (1 unit.) *Staff*

Dance Composition, Improvisation, and Repertory

130. 230. Repertory: Elementary. Half-course. (2 units.) *Staff*

131. 231. Improvisation/Composition: Elementary. Half-course. (2 units.)
Staff

132. 232. Improvisation/Composition: Elementary/Intermediate. Half-course. (2 units.) *Staff*

133. 233. Improvisation/Composition: Intermediate. Half-course. (2 units.)
Staff

134. 234. Repertory: Intermediate. Half-course. (2 units.) *Staff*

135. 235. Repertory: Intermediate/Advanced. Half-course. (2 units.) *Staff*

136. 236. Composition: Intermediate/Advanced. Half-course. (2 units.) *Staff*

137. 237. Improvisation/Technique: Intermediate/Advanced. Half-course.
(2 units.) *Staff*

138. 238. Repertory: Advanced. Half-course. (2 units.) *Staff*

140. 240. Performing Experience. Quarter-course. (1 unit.) *Staff*

Related Areas

150. 250. Elements of Performing. Half-course. (2 units.) *Staff*

151. 251. Jazz Styles. Half-course. (2 units.) *Staff*

152. 252. Dancers and Music. Half-course. (2 units.) *Staff*

160. 260. African Styles. Half-course. (2 units.) *Staff*

170. 270. Anatomy/Kinesiology for Dancers. Half-course. (2 units.) *Staff*

171. 271. **Injury Problems of Dancers: Rehabilitation and Re-education I.** Half-course. (2 units.) *Staff*

172. 272. **Injury Problems of Dancers: Rehabilitation and Re-education II.** Half-course. (2 units.) *Staff*

178. 278. **Therapeutic Massage.** Half-course. (2 units.) *Staff*

180. 280. **Fundamentals of Body Movement.** Half-course. (2 units.) *Staff*

181. 281. **Introduction to Effort/Shape I.** Half-course. (2 units.) *Staff*

182. 282. **Introduction to Effort/Shape II.** Half-course. (2 units.) *Staff*

183. 283. **The Alexander Technique.** Half-course. (2 units.) *Staff*

186. 286. **Dance Therapy I.** One course. (4 units.) *Staff*

187. 287. **Dance Therapy II.** One course. (4 units.) *Staff*

198. 298. **Stagecraft for Dance.** Half-course. (2 units.) *Staff*

199. 299. **Dance Production Seminar.** Half-course. (2 units.) *Staff*

History (HST)

Professor Durden, *Chairman* (235 Allen Building); Professor Richards, *Director of Graduate Studies* (237 Allen Building); Professor Davis, *Director of Undergraduate Studies* (231 Allen Building)

21. **Europe to the Eighteenth Century.** Development and world impact of European civilization; critical evaluation of historical interpretations; investigation of history from primary sources. One course. *Lerner*. Term I. 9:50–11:20. W53, 226

22. **Europe from the Eighteenth Century.** Development and world impact of European civilization; critical evaluation of historical interpretations; investigation of history from primary sources. One course. *Hollyday*. Term II. 9:50–11:20. W53, 225

53. **Greek History.** One course. *Oates*. Term I. Footnote: C. XREF: CS 053. 9:50–11:20. W5, 219

91. **The Development of American Democracy to 1865.** A study of the trends vital to an understanding of the United States today. The main theme is the development of American democracy. Problems of foreign policy, the growth of capitalism, political practices, social reform, and conflicting ideals are considered in relation to this main theme. One course. *Butts*. Term I. 8:00–9:30. W53, 226

92. **The Development of American Democracy, 1865 to the Present.** A continuation of History 91 with emphasis upon the emergence of contemporary problems in the United States. One course. *Davis*. Term II. 8:00–9:30. W53, 225

95. **The Roman Revolution.** One course. *Oates*. Term I. Footnote: C. XREF: CS 137. 11:40–1:10. W5, 219

101T. **Class and Community in a New South City.** The impact of industrialization on work, family, religion, and ideology of working people of the South, 1870–1950; a selected industrial community within Durham, N.C., will be the focus of observation, archival and photographic research, and oral interviews. One course. *Nathans*. Term I. Footnote: 2 11:00–12:30. W4, 230A

101Z. **Visions of the South.** Images of the New South; perceptions of southern folk culture, black and white; southern liberalism, northern liberalism, and the vision of social change in the twentieth century. Special use will be made

of regional resources and archives as a focus for study. One course. *Jackson*. Term I. Footnote: 2. 11:00–12:30. W4, 027

122. Diplomatic History of the United States. Emphasis on those factors, foreign and domestic, that have shaped the foreign policies of the republic. One course. *Davis*. Term II. 11:40–1:10. W53, 225

140. Europe in the Era of German Ascendancy. International tensions, industrialization, socialism, state intervention, Darwinism, expressionism in art and literature, crises in Imperial Germany and Austria-Hungary from Bismarck to the collapse in 1918. One course. *Hollyday*. Term II. 11:40–1:10. W53, 234

158. The Rise of Modern Science. The development of science and medicine, with attention to cultural and social influences upon science. Eighteenth to twentieth centuries. One course. *Mauskoph*. Term I. 11:40–1:10. W53, 234

165. Paths to the Modern South. Four dimensions of southern history and culture are examined and compared: art and architecture, kinship and family patterns, industrialization and the community, images of the South. The course explores common southern cultural patterns, the sources of diversity, and the roots of change in the twentieth century. This course must be taken in conjunction with a seminar in one of the topic areas, e.g. architecture, kinship, industrialization, images of the South. (See the program description in this bulletin.) One course. *Nathans, Brown, Jackson, and Jones*. Term I. Footnotes: 2, C. XREF: IDC 165. 8:50–10:20. W4, 301

191. Independent Study. One course. *Staff*. Terms I, III. Footnote: A. TBA

192. Independent Study. One course. *Staff*. Term II. Footnote: A. TBA

213. Medicine and Society in America. The evolution of the medical profession, the emergence of modern medical science, patterns and possibilities for medical care and health-related ethical issues considered in their historical contexts and against the background of contemporary America. One course. (3 units.) *Gifford*. Term II. 9:50–11:20. W53, 234

232S. Problems in the History of Spain and the Spanish Empire. One course. (3 units.) *TePaske*. Term III. 11:40–1:10. W53, 234

261. Problems in Soviet History. Studies in the background of the Revolution of 1917 and the history and politics of the Soviet state. One course. (3 units.) *Lerner*. Term I. 11:40–1:10. W53, 226

277S. The Coming of the Civil War in the United States, 1820–1861. One course. (3 units.) *Durden*. Term III. 9:50–11:20. W53, 234

399. Independent Study. Supervised independent study and reading, with consent of professor. (3 units.) *Staff*. Terms I, II, III. Footnote: A. TBA

Interdepartmental Courses (IDC)

165. Paths to the Modern South. Four dimensions of southern history and culture are examined and compared: art and architecture, kinship and family patterns, industrialization and the community, images of the South. The course explores common southern cultural patterns, the sources of diversity, and the roots of change in the twentieth century. This course must be taken in conjunction with a seminar in one of the topic areas, e.g. architecture, kinship, industrialization, images of the South. (See the program description in this bulletin.) One course. *Nathans, Brown, Jackson, and Jones*. Term I. Footnotes: 2, C. XREF: HST 165. 8:50–10:20. W4, 301

Management Sciences (MS)

Professor Keller, *Chairman* (115 Social Sciences Building); Professor Dickens, *Director of Undergraduate Studies* (104 Social Sciences Building)

50. Elementary Theory of Economic Enterprise. Analysis of the internal resource allocation of the firm, market structures, and capital theory and the mathematical foundations for this analysis. Prerequisites: Mathematics 31, 36, or equivalent. (Not open to students who have taken Economics 2 or 52.) One course. *Staff.* Term I. Footnote: P. 9:50–11:20. W10, 220

53. Introductory Financial Accounting. The accounting model of the firm and transactions analysis. Topics include the procedures used to process accounting data, issues in asset valuation and income determination, and financial statement analyses. Prerequisite: Mathematics 31. Corequisite: Management Sciences 50 or equivalent. One course. *Staff.* Term I. Footnote: P. 8:00–9:30. W10, 220

110. Probability and Statistics. Probability theory and distributions. Classical statistical analysis and its application to decision problems. Estimation, hypothesis testing, regression, and correlation analysis. (Not open to students who have taken Public Policy Studies 112, Economics 138, Mathematics 53, or Engineering 150.) Prerequisite: Mathematics 31, 36 or equivalent. Corequisite: Management Science 50. One course. *Staff.* Term II. Footnotes: C, P. XREF: ECO 138. 9:50–11:20. W10, 220

120. Analysis of Organizational Behavior. The structure and behavior of organizations, with special reference to business firms. Topics include rationality, authority, bureaucracy; power, decision making, informal organization, organization change; effects of technology, culture, and other environmental influences. Prerequisite: Management Sciences 50. One course. *Staff.* Term I. Footnote: P. 1:30–3:00. W10, 220

137. Managerial Accounting. The use of accounting information by management in short-term planning, control, and decision making in business enterprises. Cost accumulation, cost analysis, cost estimation, the development of standards, introduction to budgeting, and short-run decisions. Prerequisite: Management Sciences 53. Corequisite: Management Sciences 114. One course. *Staff.* Term II. 8:00–9:30. W10, 220

145. Federal Income Taxation. Principles of federal income tax laws related to corporations and individuals. Tax planning and the effect of tax law on business decisions will be emphasized. Prerequisite: junior standing and Management Sciences 53. (4 units.) *Staff.* Term I. Footnote: P. 8:30–10:20. W10, 225

231. Intermediate Financial Accounting. Requirements of investors, auditors, unions, and governments for information about the status and operations of firms and a framework for disclosure of the relevant data. Prerequisite: Management Sciences 53. (4 units.) *Staff.* Term I. 10:30–12:20. W10, 225

232. Internal Control and Auditing. The independent auditor's examination of the accounting control system and other evidence as a basis for expressing an opinion on a client's financial statements. Basic audit objectives, standards, ethics, terminology, procedures, and reports. Prerequisites: Management Sciences 137 and 231. (4 units.) *Staff.* Term II. 8:30–10:20. W10, 225

234. Advanced Financial Accounting. Accounting for and reporting on the diverse activity of multiproduct, multidivisional, multinational organizations. Organizations with and without profit goals are studied. Prerequisites: Management Sciences 137, 231. (4 units.) *Staff.* Term II. 10:30–12:20. W10, 225

Mathematics (MTH)

Professor Warner, *Chairman* (135-C Physics Building); Professor Reed, *Director of Graduate Studies* (215 Physics Building); Professor Murray, *Director of Undergraduate Studies* (135 Physics Building)

31. Introductory Calculus. Limits and continuity; transcendental functions; techniques and applications of the differential calculus. Prerequisite: three years of college preparatory mathematics. One course. *Staff*. Terms I, II. 8:00–9:20. W49, 132

32. Introductory Calculus. Theory and applications of the definite integral; techniques of integration; infinite sequences and infinite series. (Not open to students who have had Mathematics 36.) Prerequisite: Mathematics 31. One course. *Staff*. Terms I, II, III. 11:20–12:40. W49, 132

53. Basic Statistics. Statistical concepts involved in making inferences, decisions, and predictions from data. Techniques not emphasized. (Not open to students who have had Economics 138 or Psychology 117.) One course. *Burdick*. Term I. 9:40–11:00. W49, 132

191. Independent Study. Directed reading and research. Admission by approval of instructor and Director of Undergraduate Studies. One course. *Staff*. Term I. Footnote: A. TBA

213. Linear Algebra. Matrices, linear transformations, linear equations, bilinear forms; geometry of vectors in Euclidean space; applications to plane and solid geometry. (3 units.) *Weisfeld*. Term II. 9:40–11:00. W49, 132

214. Modern Algebra for Teachers. Modern developments and approaches to the study groups, rings, and fields; applications to the teaching of high school mathematics. (3 units.) *Hodel*. Term III. 9:40–11:00. W49, 128

270. General Topology. Basic topological properties, including compactness, connectedness, separation axioms, and countability properties; metric spaces and completeness; product spaces and function spaces. Prerequisite: Mathematics 139 or equivalent. One course. *Warner*. Term III. 11:20–12:40. W49, 128

399. Special Readings. *Staff*. Term III. TBA

Microbiology and Immunology (MIC)

Professor Joklik, *Chairman* (414 Jones Building); Professor Willett, *Director of Graduate Studies* (420 Jones Building)

The department offers graduate work leading to the Ph.D. degree. Specialization is possible in molecular virology, viral oncology, cell biology, microbial physiology, medical mycology, immunochemistry, immunogenetics, cancer immunology, and general immunology.

Undergraduate preparation in biochemistry and physical chemistry is required. A brochure describing the Ph.D. degree program, prerequisites for admission, and research in the department can be obtained by writing the Director of Graduate Studies, Box 3020, Duke Medical Center, Durham, North Carolina, 27710.

214. Fundamentals of Electron Microscopy. An introduction to the basics of electron microscopy, specimen preparation, and ultramicrotomy. Open only to graduate students in microbiology and immunology. Offered only in the summer. (2 units.) *Miller*. Term II. Footnotes: D,E. TBA

325. Medical Mycology. Comprehensive lecture and laboratory coverage of all the fungi pathogenic for humans. Practical aspects as well as future trends in

the mycology, immunology, diagnosis, pathogenesis, and epidemiology of each mycotic agent will be explored. There will be several invited lecturers, each an internationally recognized scientist, discussing their particular areas of mycological expertise and current research. Prerequisite: consent of instructor. (4 units.) *Mitchell*. Term II. Footnotes: A,E. 8:30–12:00. MDN, 422

Music (MUS)

Professor Tirro, *Chairman* (105–C Biddle Music Building, East Campus); Professor Henry, *Director of Undergraduate Studies* (078 Biddle Music Building, East Campus)

91.06. Applied Music (Classical Guitar). General instruction open to beginners. Group and individual instruction. One-half course. *Perry*. Term I. 1:30–3:00. EE, 069

125. Masterworks of Music. Historical, biographical, and analytical study of works by major composers of the seventeenth through the twentieth centuries. One course. *Henry*. Term I. 8:00–9:30. EE, 104. *Withers*. Term II. 1:30–3:00. EE, 101

181.02. Independent Study in Musical Performance. Intensive coaching and performance in chamber music at Kneisel Hall, Blue Hill, Maine. See music department for fees. *Ciampi*. Footnotes: A,V. 24 June–12 August. TBA

182.01. Independent Study in Musical Performance. See Music 181. *Ciampi*. 24 June–12 August. Footnotes: A,V. TBA

184.06. Independent Study in Musical Performance (Classical Guitar). Historical background for guitar and lute, guitar repertory, and performance technique. Open to intermediate and advanced students. Group and individual instruction. One course. *Perry*. Term I. 9:50–11:20. EE, 069

Nursing (NUR)

Professor Wilson, *Dean* (1005 School of Nursing); Assistant Professor Brundage, *Acting Director of Academic Programs* (1004 School of Nursing)

191, 192, 193, 194. Independent Study. Demonstration of self-direction in planning, implementing, evaluating, and reporting an independent learning experience. The required study for nursing majors must focus on nursing. Minimum one course. *Staff*. Terms I, II, III. Footnotes: A,L. TBA

244. Theories of Group Psychotherapy. Theories of group psychotherapy based on psychoanalytic, interpersonal communication, and group dynamics theories of psychiatry as pertinent to the practice of group psychotherapy by nurses. Exposure to and discussion of differing models and types of group therapy, and the role of the psychiatric nurse in this treatment modality. Prerequisite: consent of the instructor. Minimum one course or three units. *White*. 18 June–10 August. TBA

390. Clinical Practicum. (10 units.) *Hogue, Most*. 8 May–10 August. Footnotes: B,D. TBA. MHH, 134

391, 392, 393, 394. Independent Study. An opportunity for the graduate student to fit the curriculum to individual learning goals, both substantively and methodologically, and to demonstrate competence in self-directed learning. Variable credit. *Staff*. Terms I, II, III. Footnotes: B,D. TBA

396. Master's Thesis. (3 units.) *Staff*. Terms I, II, III. Footnotes: B,D. TBA

Pathology (PTH)

Professor Jennings, *Chairman* (M301 Davison Building); Professor Bigner, *Director of Graduate Studies* (M301 Davison Building)

361. Autopsy Pathology. A detailed consideration of the morphologic, physiologic, and biochemical manifestations of disease. Emphasis is on individual work in the laboratory with tutorial supervision. Gross dissection, histologic examination, processing, and analyzing of morphologic, microbiologic, and biochemical data, and interpretation of results. For advanced students. Prerequisites: Pathology 250 and consent of instructor. (3–6 units.) *Staff.* Term I. TBA

362. Autopsy Pathology. Continuation of Pathology 361. Prerequisite: Pathology 361 or consent of instructor. (3–6 units.) *Staff.* Term II. TBA

382. General Pathology for Toxicologists. General principles of pathology and pathobiology for graduate students in toxicology who do not have a background in medicine. Principles of cell injury, inflammation, circulatory disturbances, and neoplasia using toxicologic principles and models. Prerequisites: biochemistry, physiology, microbiology, and histology, or by special permission of instructor. One course. (3 units.) *Jennings and staff.* Term II. 9:50–11:20. Thursday. 1:00–4:00. TBA

Philosophy (PHL)

Professor Golding, *Chairman* (201–C West Duke Building, East Campus); Professor Sanford, *Director of Graduate Studies* (201 West Duke Building, East Campus); Professor Welsh, *Director of Undergraduate Studies* (201 West Duke Building, East Campus)

43S. Introduction to Philosophy. Examination of problems in philosophy; emphasis on metaphysics and theory of knowledge. One course. *Ross.* Term I. 9:50–11:20. W9, 133. *Sanford.* Term II. 9:50–11:20. W9, 128

44S. Introduction to Philosophy. Examination of problems in philosophy; emphasis on ethics and value theory. One course. *Fjeld.* Term III. 9:50–11:20. W9, 128

48. Logic. A study of the conditions of effective thinking and clear communication. Examination of the basic principles of deductive reasoning. One course. *Welsh.* Term II. 11:40–1:10. W9, 129

166 and 167S. Ethics and the Professions. Classical and contemporary ethical theories and secular and Judaeo-Christian moral traditions as contexts for considering the ethical problems of the professions. Lectures accompanied by discussions of particular professions, e.g., law, medicine, engineering, and business. To be taken concurrently. Two courses. *McCullough, Pearsall, Roberts, Smith.* Term I. Footnotes: C,3. XREF: REL 166, REL 167S. 9:00–12:00. W59, 104

Physical Therapy (PT)

Professor Bartlett, *Chairman* (045 Hospital); Associate Professor Branch, *Director of Graduate Studies* (045 Hospital)

240. Prosthetics and Orthotics. (2 units.) *Staff.* Footnote: B. 7 May–8 June. TBA. M, 042

243. Directed Clinical Experience. (2 units.) *Staff.* Footnote: B. 18 June–17 August. TBA

Physics (PHY)

Professor Walker, *Chairman* (118 Physics Building); Professor Evans, *Director of Graduate Studies* (112 Physics Building); Professor Han, *Director of Undergraduate Studies* (212 Physics Building)

32. History of Physics. Theories including Newtonian Mechanics, atomic structure, quantum theory, relativity, nuclear and particle physics; their developers and technological applications. No previous knowledge of physics assumed. One course. *Palmer*. Term II. 8:00–9:50. W49, 114

33. Energy: Principles, Problems, Alternatives. Basic principles of physics as related to energy, the energy crisis, possible sources, and alternatives. Conservation, and environmental aspects of energy consumption. Optional special topics laboratory. No previous knowledge of physics assumed. One course. *Robinson*. Term I. 9:50–11:20. W49, 114

51. General Physics. Basic principles of general physics treated quantitatively. Designed for students entering medicine, engineering, and the sciences. Not open for credit to students who have completed Physics 41, 42. Students planning to major in physics should enroll in Physics 41, 42 in their freshman year. Prerequisites: Mathematics 31, 32 or equivalent. One laboratory course. *Evans*. Term I. Footnote: N. 9:40–4:00. W49, 113

52. General Physics. A continuation of Physics 51. One laboratory course. *Evans*. Term II. 9:40–4:00. W49, 113

55. Introduction to Astronomy. Man's evolving theory of the physical universe. Cosmological models, galaxies, stars, interstellar matter, the solar system, and experimental techniques and results. Several observatory sessions per semester. One course. *Kolena*. Term III. 9:50–11:20. W49, 140

255. Astronomy for Teachers. Observational techniques and the use of the telescope. Evolution of planetary atmospheres and interiors, stellar evolution, galaxies, cosmology. Observatory observation. One course. *Kolena*. Term III. 9:50–11:20. W49, 140

Physiology (PHS)

Associate Professor Salzano, *Acting Chairman* (388 Nanaline H. Duke); Professor Ottolenghi, *Director of Graduate Studies* (453 Nanaline H. Duke)

212. Membrane Physiology and Osmoregulation. Physiology of marine and estuarine organisms, with emphasis on cellular transport and electrophysiology. Includes the functions, mechanisms, and comparative aspects of ionic and osmotic regulation in aquatic plants and animals. Laboratory work deals with membrane transport in single cells and epithelia, renal and gill transport in fish, amino acid transport and metabolism in crustaceans, and applications of radiotracer and other physical and chemical techniques to the study of membrane function. Prerequisite: permission of instructor. (Given at Beaufort.) One and one-half courses. (6 units.) *Gutknecht*. Term III. Footnotes: I,X. TBA

221. Electrophysiological Techniques. Instruction and practice with emphasis on intracellular recording and stimulating techniques. Topics include: fabrication and use of microelectrodes, electronic instrumentation, voltage clamping, microiontophoretic techniques, as well as bioelectric data processing and modeling. Format will include lectures and demonstrations, but the main effort will be devoted to practice work in the laboratory. Prerequisites: Biomedical Engineering

101 or Physiology 225, or permission of instructor. One laboratory course. (4 units.) *Wachtel and staff*. Term I. Footnote: C. XREF: BME 221. TBA

Political Science (PS)

Professor Spragens, *Acting Chairman* (313 Perkins Library); Professor Hall, *Director of Graduate Studies* (315 Perkins Library); Professor Eldridge, *Director of Undergraduate Studies* (214-A Perkins Library)

91. The American Political System. Theory and practice of American government and politics; federal-state relations; the separation and interrelationships of the executive, legislative, and judicial branches of government; judicial review; the role of political parties and public opinion; the formulation and execution of domestic and foreign policy; civil liberties. One course. *Kornberg*. Term II. 9:50–11:20. W4, 301

93. Elements of International Relations. The nature of international politics, the analysis of national power, the instruments of foreign policy, and the controls of state behavior. One course. *Eldridge*. Term II. 1:30–3:00. W4, 301

94. Contemporary Political Ideologies. Liberalism, socialism, Marxism and its variants, fascism, contemporary democratic theory. One course. *Spragens*. Term I. 9:50–11:20. W4, 307

116. Introduction of Islamic Civilization. One course. *Faksh*. Term II. 8:00–9:30. W4, 301

157. Foreign Policy of the United States. Sources of American foreign policy, containment, international economic policy, deterrence, arms control, and disarmament. Prospects in the post-Vietnam era. Emphasis on the period since World War II. One course. *Kruzel*. Term I. 8:00–9:30. W4, 307

191. Independent Study. Directed reading and research. Open only to qualified juniors by consent of the Director of Undergraduate Studies and of the individual instructor. One course. *Staff*. Terms I, II, III. Footnote: A. TBA

210. The Politics of Education. The forces in local, state, and national politics which impinge on educational policy-making and administration. Not open to students who have had Political Science 313. One course. (3 units.) *Leach*. Term II. XREF: EDU 210. 11:40–1:10. W4, 301

246. Administration and Public Policy. The role of administration in the American policy process. One course. (3 units.) *Hall*. Term III. 9:50–11:20. W4, 301

308. Individual Research in Political Science. Students will conduct research designed to evaluate hypotheses of their choice. Reports on the research must be presented in adequate professional style. (3 units.) *Staff*. Terms I, II, III. TBA

399. Special Readings. Variable credit. *Staff*. Terms I, II, III. TBA

Psychology (PSY)

Professor Kimble, *Chairman* (224 Sociology-Psychology Building); Professor Stadson, *Director of Graduate Studies* (242 Sociology-Psychology Building); Professor Wing, *Director of Undergraduate Studies* (316 Sociology-Psychology Building)

11. Introductory Psychology. Biological bases of behavior, psychological development, cognitive psychology, personality, abnormal behavior, and social psychology. One course. *Kimble*. Term II. 9:50–11:20. W9, 127

102. Sensation, Perception, and Learning. Sensation, including psychophysics and receptor processes. The concept of reflex, both physiological (Sher-rington) and behavioral (Pavlov). Complex organization: learning, perception, and cognition. One course. *Lockhead*. Term I. 8:00–9:30. W9, 127

103. Biological Basis of Behavior. Behavior as a product of evolution and the role of behavior in species survival. Neural and endocrine factors in reproduction, hunger, thirst, emotion, and intelligence. Hereditary-environment in the development of behavior. One course. *Nowakowski*. Term I. 11:40–1:10. W9, 127

104. Personality. Representative theories of personality, from Freud to the present, emphasizing problems of normal personality structure, dynamics, development, and assessment. One course. *Lakin*. Term I. 8:00–9:30. W9, 319

105. Developmental Psychology. Theory and research on growth and behavior from infancy to adolescence. One course. *Bordeaux*. Term II. 8:00–9:30. W9, 127

117. Statistical Methods in Psychology. Elementary statistical techniques and their application to the analysis and interpretation of psychological data. Theory of inference is stressed. Psychology majors only. (Not open to students who have had Economics 138, Mathematics 53 or 183, or Management Sciences 110.) One course. *Buckingham*. Term II. Footnote: T. 9:50–11:20. W9, 126

138. Abnormal Psychology. Disordered behavior and constructive personality change are viewed in interpersonal and social context for purposes of understanding normal and abnormal personality development and functioning. Prerequisite: Psychology 104 or 105. One course. *Lakin*. Term I. Footnote: P. 9:50–11:20. W9, 319. *Carson*. Term III. Footnote: P. 9:50–11:20. W9, 127

177. Independent Study and Research. Prerequisites: formulation of a study plan with a faculty supervisor and approval of the director of undergraduate studies; Psychology 102 or 103, 104 or 105, and one psychology course numbered 140 through 149; Psychology 117 recommended. One course. *Staff*. Terms I, II, III. Footnote: A. TBA

178. Independent Study and Research. Prerequisites: formulation of a study plan with a faculty supervisor and approval of the director of undergraduate studies; Psychology 102 or 103, 104 or 105, and one psychology course numbered 140 through 149; Psychology 117 recommended. One course. *Staff*. Terms I, II, III. Footnote: A. TBA

Public Policy Studies (PPS)

Professor Fleishman, *Chairman* (114 Old Chemistry Building); Professor Cook, *Director of Graduate Studies* (107 Old Chemistry); Professor Kuniholm, *Director of Undergraduate Studies* (109-E Old Chemistry)

Field Experience/Internship

The institute's internship courses provide students with an opportunity to develop a basic understanding of one or more public policy areas, to apply that understanding in a job during the summer, and to return to the classroom to build on this knowledge and experience. Students take a substantive policy course in the spring preceding their summer experience.

The internship period is ten weeks, beginning the last week of May and ending the last week of July. All students in internship courses (listed below) will register for a 3-hour course during Term I, and will pay the tuition normally required for that course. All of the participants in these internship courses will

attend weekly seminars during the summer in the cities where their internships are assigned: health and communications in Washington, D.C.; justice in Raleigh/Durham. In the fall semester, all majors will select advanced course work to build on their summer experiences, subject to the approval of the Director of Internship Programs and the Director of Undergraduate Studies. Course credit will be given on a pass/fail basis for the summer internship courses. The internship courses do not count as upper level electives required for the major. They do count toward course credits needed for graduation.

The following internship courses are offered by the institute:

152S. Administration of Justice, Summer Internship. Prerequisite: Public Policy Studies 151. One course. *Staff*. Footnotes: A,S. 21 May–27 July. TBA

155S. Communications Policy, Summer Internship. Prerequisite: Public Policy Studies 154. One course. *Staff*. Footnotes: A,S. 21 May–27 July. TBA

158S. Health Policy, Summer Internship. Prerequisite: Public Policy Studies 157. One course. *Staff*. Footnotes: A,S. 21 May–27 July. TBA

Religion (REL)

Professor Poteat, *Chairman* (117–B Gray Building); Professor Osborn, *Director of Undergraduate Studies* (324 Gray Building); Professor Smith, *Director of Graduate Studies* (209 Old Divinity)

50. The Old Testament. Historical, literary, and theological investigations. Not open to students who have had Religion 55 or 55D. One course. *Jones*. Term II. 8:00–9:30. W3, 220

52. The New Testament. Origins, development, and content of thought. Not open to students who have had Religion 55 or 55D. One course. *Price*. Term I. 8:00–9:30. W3, 220

57. Introduction to Religions of Asia. Problems and methods in the study of religion, followed by a survey of the historical development, beliefs, practices, and contemporary significance of the Islamic religion and religions of South and East Asia. One course. *Lawrence*. Term I. 9:50–11:20. W3, 220

58. Interpretations of Religion in Western Culture. Western religion as explained by contemporary sociologists, psychologists, anthropologists, and theologians. One course. *Bland*. Term II. 9:50–11:20. W3, 220

141. Religions of China and Japan. Traditional religion in China and Japan and its interaction with Sino-Japanese Buddhism. One course. *Corless*. Term III. 9:50–11:20. W3, 220

148. Modern American Religious Cults. Children of God, Unification Church, Scientology, Fereria, Transcendental Meditation, Krishna Consciousness, and Bahai, and others. One course. *Partin*. Term II. 11:40–1:10. W3, 220

166–167S. Ethics and the Professions. Classical and contemporary ethical theories and secular and Judaeo-Christian moral traditions as contexts for considering the ethical problems of the professions in society. Lectures accompanied by discussions of particular professions, e.g., law, medicine, engineering, business. To be taken concurrently. Two courses. *McCullough*. Term I. Footnotes: C,3. XREF: PHL 166, PHL 167S. 9:00–12:00. W59, 104

194. Independent Study. For juniors and seniors with departmental approval. One course. *Staff*. Terms I, II, III. Footnote A. TBA

196A. The Latin American Church and Liberation. The response of the Latin American Church to poverty and oppression from Medellin to Puebla (1968–78). By permission of the instructor. *Osborn*. Term II. Footnotes: A,S,1. TBA

196B. The Bible and Marx in Latin America. An examination of the use of these two sources by liberation theologians of Latin America. By permission of the instructor. *Osborn*. Term II. Footnotes: A,S,1. TBA

399. Special Readings. Variable credit. *Staff*. Terms I, II. Footnote: A. TBA

Romance Languages

Professor Tetel, *Chairman* (205–A Languages Building); Professor Vincent, *Director of Graduate Studies* (214 Languages Building); Professor Bryan, *Director of Undergraduate Studies in French* (212 Languages Building); Professor Garci-Gómez, *Director of Undergraduate Studies in Spanish* (301 Languages Building)

FRENCH (FR)

1. Elementary French. Understanding, speaking, reading, and writing French. Language laboratory available for recording/listening practice. One course. *Hull*. Term I. Footnote: T. 11:40–1:10. W5, 211

2. Elementary French. Understanding, speaking, reading, and writing French. Language laboratory available. One course. *Bryan*. Term II. Footnote: T. 9:50–11:20. W5, 305

76. Introductory French Conversation. Practice in everyday conversational French. Prerequisite: French 63 or equivalent. Enrollment: maximum fifteen students. One course. *Bryan*. Term II. Footnote: T. 11:40–1:10. W5, 305

123. Active French. Conversation and exposés on contemporary subjects. Prerequisite: French 76 or equivalent or consent of instructor. One course. *Tetel*. Term I. 11:40–1:10. W5, 305

130. Modern French Civilization. Nineteenth- and twentieth-century France, history, institutions, customs, and arts. Readings and discussions in French. One course. *Tetel*. Term I. 9:50–11:20. W5, 211

191. Independent Study. Directed reading and research. Open only to qualified juniors by consent of instructor and the Director of Undergraduate Studies. One course. *Hull*. Term I, section 11. Footnote: A. TBA. *Tetel*. Term I, section 19. Footnote: A. TBA

192. Independent Study. Directed reading and research. Open only to qualified juniors by consent of instructor and the Director of Undergraduate Studies. One course. *Staff*. Term II. Footnote: A. TBA

193. Independent Study. Directed reading and research. Open only to qualified seniors by consent of the instructor and of the Director of Undergraduate Studies. One course. *Hull*. Term I, section 11. Footnote: A. TBA. *Tetel*. Term I, section 19. Footnote: A. TBA

194. Independent Study. Directed reading and research. Open only to qualified seniors by consent of instructor and the Director of Undergraduate Studies. One course. *Staff*. Term II. Footnote: A. TBA

ITALIAN (IT)

181. Intensive Italian. An introduction to the language. Prerequisite: four semesters of another foreign language or consent of instructor. One course. *Caserta*. Term I. Footnote: T. 9:50–11:20. W5, 217

191.05. Independent Study. Directed reading and research. Open only to qualified juniors by consent of instructor and of the Director of Undergraduate Studies. One course. *Caserta*. Term I. Footnote: A. TBA

193.05. Independent Study. Directed reading and research. Open only to qualified seniors by consent of instructor and the Director of Undergraduate Studies. One course. *Caserta*. Term I. Footnote: A. TBA

SPANISH (SP)

1. Elementary Spanish. Understanding, speaking, reading, and writing Spanish. Language laboratory available for recording-listening practice. One course. *Byrd*. Term I. Footnote: T. 9:50–11:20. W5, 305

2. Elementary Spanish. Reading and writing Spanish. Readings in modern literature. One course. *C. Soufas*. Term II. Footnote: T. 9:50–11:20. W5, 217

76. Introductory Spanish Conversation. Practice in everyday conversational Spanish. Prerequisite: Spanish 63 or equivalent. Enrollment: maximum fifteen students. One course. *C. Soufas*. Term II. Footnote: T. 11:40–1:10. W5, 217

110. Spoken Spanish. Study of colloquial Spanish; practice in pronunciation in conversation; emphasis on oral communication. Prerequisite: Spanish 76 or consent of instructor. Limited to fifteen students. One course. *Staff*. Term I. 9:50–11:20. W5, 208

153S. Contemporary Women Novelists. *Byrd*. Term I. 11:40–1:10. W5, 208

Duke Summer Program in Spain

153S. Spanish Language and Culture. One course. *Garci-Gómez*. Footnotes: A,Y. 23 May to 26 June. TBA

191.10. Independent Study. Directed reading and research. Open only to qualified juniors by consent of instructor and Director of Undergraduate Studies. One course. *Garci-Gómez*. Footnotes: A,Y. 23 May to 26 June. TBA

193.10. Independent Study. Directed reading and research. Open only to qualified seniors by consent of instructor and Director of Undergraduate Studies. One course. *Garci-Gómez*. Footnotes: A,Y. 23 May to 26 June. TBA For further information contact Professor Miguel Garci-Gómez, 203 Romance Languages.

Science and Mathematics Institute for Teachers

These courses, for both prospective and practicing teachers, will be offered if demand is adequate. If interested, write immediately to Professor Pelham Wilder, Jr., Department of Chemistry, Duke University, Durham, North Carolina 27706 so that enrollments can be assessed at an early date. These courses may be applied toward the M.Ed. degree and the M.A.T. degree. Some state scholarships for tuition may be available to teachers under contract in a North Carolina public school. Chemistry 213 and 214 are applicable toward the Gifted and Talented Teaching Certificate.

Chemistry 213–214. Introductory Physical and Quantitative Chemistry: A Course for the AP Teacher. Intensive study of major topics covered in the AP

chemistry course, including atomic and molecular structure, stoichiometry, elementary thermodynamics, chemical kinetics, electrochemistry, and physical chemistry of aqueous solutions. All day, five weeks, Monday through Friday, 19 June–21 July. Lecture, laboratory, conferences. 6 graduate units. *Wilder*. 8:30–11:30, 1:00–4:00. W65, 103

Education 287, 288. Physical Science for Teachers, I and II. Study of the major topics of introductory physics (I) and chemistry (II) with emphasis on laboratory work suitable for grades nine through twelve. Lecture and laboratory. 3 graduate units per course. *Githens*. 19 June–21 July. 8:30–11:30, 1:00–4:00. W65, 104

See also Physics 255 (Astronomy) in the third term.

Sociology (SOC)

Professor Back, *Chairman* (268 Sociology-Psychology Building); Professor Campbell, *Director of Graduate Studies* (254 Sociology-Psychology Building); Professor Simpson, *Director of Undergraduate Studies* (253 Sociology-Psychology Building)

91. Introduction to Sociology. One course. *Smith*. Term I. 8:00–9:30. W9, 129. *Rice*. Term II. 11:40–1:10. W9, 129

101. Contemporary American Society. Social trends and social problems and their effects on individuals and society. Urbanization; bureaucracy; distribution of wealth, income, and power; status of minorities. One course. *Preiss*. Term II. 8:00–9:30. W9, 133

111. Inequality in America. Differences in social position in the United States as they relate to income, prestige, and power. Primary focus on the process of achievement, including level of education, and occupational position, while controlling for race, sex, and age. One course. *Zipp*. Term I. 9:50–11:20. W9, 129

120. Perspectives on Deviant Behavior. Development and distribution of deviant social behavior, treating such topics as social disorganization, stress and strain, cultural and labeling theories in relation to crime and delinquency, drug addiction, homosexuality, suicide, or others. (Not open to students who have taken Sociology 143.) One course. *Rice*. Term II. 9:50–11:20. W9, 248

150. The American Family. The American family as an institutionalized group and its relationship with other institutions; the social psychology of family relations; variations by social class and ethnic group. One course. *Simpson*. Term I. 8:00–9:30. W9, 248

165. Occupations and Career Development. How occupations organize and control labor markets, define services, chart career lines, and develop and sustain occupational identities. One course. *Simpson*. Term I. 9:50–11:20. W9, 248

170. The Sociology of Mass Communication. An analysis of the role of radio, the press, magazines, movies, and television in modern societies. An examination of the selective audiences, content characteristics, controlling elements, and organizational structure of the various media of mass communication. Comparative Canadian material considered where feasible. One course. *Smith*. Term I. 11:40–1:10. W9, 248

173. Social Movements. Social movements as agents of change. Structure and development of protest groups. One course. *Wilson*. Term III. 9:50–11:40. W9, 248

272. The Socialization Process. Mechanisms and variations in socialization by position in the social structure (class, race, urban-rural); contributions made by

various socialization agencies (family, school, peer groups, mass media) in Western society. One course. (3 units.) *Preiss.* Term II. 11:40–1:10. W9, 248

Zoology (ZOO)

Professor Wainwright, *Chairman* (227 Biological Sciences Building); Professor Tucker, *Director of Graduate Studies* (0040 Biological Sciences Building); Professor Fluke, *Director of Undergraduate Studies* (117 Biological Sciences Building)

The Department of Zoology manages a variety of programs tailored to individual needs of students seeking B.A., B.S., A.M., or Ph.D. degrees.

Students seeking undergraduate degrees should consult the *Bulletin of Undergraduate Instruction* for a statement of major requirements. A departmental handbook, available from the office of the Director of Undergraduate Studies, describes the advising system, typical courses of study, special programs, and interest and background of the faculty.

In general, graduate students entering the department will be equipped to pursue an advanced degree if they have completed an undergraduate major in biology, along with some formal training in college-level chemistry, mathematics, physics, and foreign languages.

Nevertheless, in recognition and support of the modern trend toward interdisciplinary research, the department is prepared to accept promising students with less orthodox academic backgrounds and is ready to encourage any student wishing to undertake a program of study leading, in effect, to an interdisciplinary degree sponsored by the department.

Thus, all students are urged to search widely in the *Bulletin of Undergraduate Instruction* and the *Bulletin of the Graduate School* for information about the intellectual resources of the University. Special attention, perhaps, should be given to announcements of the Departments of Anatomy, Biochemistry, Botany, Chemistry, Geology, History, Mathematics, Microbiology and Immunology, Philosophy, Physics, Physiology, Pharmacology, Psychology, Sociology, Anthropology, and Zoology; announcements of the Schools of Engineering and Forestry should also be consulted. For further information on the offerings at Beaufort, see the *Bulletin of the Duke University Marine Laboratory*.

114L. Introduction to Biological Oceanography. Physical, chemical, and biological processes of the oceans, emphasizing special adaptations for life in the sea and factors controlling distribution and abundance of organisms. Laboratory emphasis. Not open to students who have had Geology 53 or Botany 53. Prerequisite: introductory biology. (Given at Beaufort.) One and one-half courses. *Staff.* Term I. Footnotes: I,X. TBA

176L. Marine Invertebrate Zoology. Lectures, reading, and laboratories emphasizing examples of major marine phyla and classes collected from estuarine and marine habitats. Not open to students who have had Zoology 175, 274, or 275. Prerequisite: introductory biology. (Given at Beaufort.) One and one-half courses. *Bookhout.* Term I. Footnotes: I,X. TBA

191. Independent Study. For junior and senior majors with consent of the Director of Undergraduate Studies and the supervising instructor. Three courses of 191, 192, 193T, and 194T maximum. Credit to be arranged. *Costlow.* Term I, section 50. *Fluke.* Terms I, III, section 52. *Gillham.* Term I, section 56. *Livingstone.* Terms I, III, section 62. *Sutherland.* Term I, section 72. *Vogel.* Term III, section 76. *Wilbur, K.* Term I, section 84. Footnote: A. TBA

192. Independent Study. For senior and junior majors with permission of the appropriate Director of Undergraduate Studies and the supervising instructor.

Course credit to be arranged. *Fluke*. Term II, section 52. *Livingstone*. Term II, section 62. *Sutherland*. Term II, section 72. *Vogel*. Term II, section 76. Footnote: A. TBA

193T. Tutorial. For junior and senior majors with consent of the Director of Undergraduate Studies and the supervising instructor. Three courses of 191, 192, 193T, and 194T maximum. Credit to be arranged. *Staff*. Terms I, III. Footnote: A. TBA

194T. Tutorial. For senior and junior majors with consent of the Director of Undergraduate Studies and the supervising instructor. Course credit to be arranged. *Staff*. Term II. Footnote: A. TBA

203L. Marine Ecology. Application of ecological theory to marine systems. Mathematical properties of population growth and species interactions; field and laboratory projects with computer-assisted analysis of data. Practice in scientific writing. Readings from current scientific publications. Prerequisites: introductory biology or invertebrate zoology and calculus. Knowledge of statistics helpful. (Given at Beaufort.) One and one-half courses. (6 units.) *Sutherland*. Term II. Footnotes: I,X. TBA

214L. Biological Oceanography. Impact of biological processes on the physical and chemical character of the environment and the regulating role of abiotic processes on organic productivity. Factors regulating primary and secondary productivity with the estuary and ocean as examples. Emphasis on design and execution of directed research. Prerequisite: consent of instructor, introductory biological or chemical oceanography recommended. (Given at Beaufort.) One and one-half courses. (6 units.) *Barber*. Term II. Footnotes: I,X. TBA

250L. Physiological Ecology of Marine Animals. The physiology of marine animals as related to environmental factors of salinity, temperature, oxygen, and light. Prerequisite: a course in physiology. (Given at Beaufort.) One and one-half courses. (6 units.) *Forward*. Term II. Footnotes: I,X. TBA

274L. Marine Invertebrate Zoology. Structures, functions, and habits of invertebrate animals under natural and experimental conditions. Field trips included. Not open to undergraduate students who have had Zoology 175 except with consent of Director of Undergraduate Studies. Prerequisite: introductory biology. (Given at Beaufort.) One and one-half courses. (6 units.) *Seed*. Term III. Footnotes: I,X. TBA

278L. Invertebrate Embryology. Lectures, readings, and laboratory work dealing with rearing, development, and life histories of invertebrates. Prerequisites: consent of instructor. (Given at Beaufort.) One laboratory course. (4 units.) *McClay*. Term III. Footnotes: I,X. TBA

281L. Marine Invertebrate Larvae. Descriptive survey of life cycles, developmental stages, and metamorphosis, with emphasis on larval stages of marine invertebrates collection, identification, and culture of larval forms in estuarine, inshore and oceanic plankton, and sediments. Prerequisites: a course in zoology or consent of instructor. One laboratory course. (4 units.) *Lehman*. Term II. Footnotes: I,X. TBA

353, 354. Research. To be carried on under the direction of the appropriate staff members. Hours and credit to be arranged. *Staff*. Terms I, II, III. TBA

Directions to Summer Session Applicants

All applicants for summer session courses who are not now in residence at Duke University must fill out the application form accurately and in detail and

return it to the Director of the summer session. Preference in enrollment will be given to persons returning the form promptly, but a place in a particular course cannot be assured until all fees are paid. Undergraduates or graduates who are enrolled in a university or college other than Duke University and who are seeking to transfer summer session credits to the college in which they are matriculated should complete the course approval portion of the application and have it certified by their Dean or Registrar. *Requests for transcripts of work completed during the summer sessions should be forwarded to the Office of the Registrar, 103 Allen Building, Duke University, Durham, North Carolina 27706.* Graduate students are reminded that credit earned as an unclassified graduate student cannot be applied toward an advanced degree at Duke University. Persons applying for admission to the Graduate School of Duke University should write the Dean of the Graduate School for the necessary forms in addition to completing the application form in this bulletin.

Undergraduates, both men and women, are required to live in the residence halls unless they are married or living with parents or relatives, or have received permission to reside off campus for the previous or subsequent academic year. Any exception must be approved in advance by the Dean of Students.

Mail applications to Director of the Summer Session, 120 Allen Building, Duke University, Durham, North Carolina 27706.

Applicants for courses at the Marine Laboratory should consult the *Bulletin of the Duke University Marine Laboratory*, complete the application contained in that bulletin and forward to the Director, Duke University Marine Laboratory, Beaufort, North Carolina 28516.



APPLICATION BY NON-DUKE STUDENTS FOR ENROLLMENT IN THE DUKE UNIVERSITY
SUMMER SESSION

Mr., Ms.
(Please Print)

Address

City State Zip Code

Social Security No. Phone, Area

Please register me in the following courses:

Term	Department	Course No.	Course Title
.....
.....
.....

Non-Duke students in good standing in their respective institutions will be admitted as unclassified students for the summer session ONLY. Please check the appropriate level.

☐ Prebaccalaureate ☐ Postbaccalaureate

Have you previously attended Duke? ☐ Yes ☐ No

If yes, give dates

Name and address of high school from which you graduated

Are you at present a college student? ☐ Yes ☐ No

If yes, give name and city of the institution

Are you a candidate for a degree? ☐ Yes ☐ No

If yes, what degree? Class

Are you in good academic standing in the above institution? ☐ Yes ☐ No

If no, explain

If not presently enrolled, have you attended college? ☐ Yes ☐ No

Highest degree held

If yes, give name(s) and address(es) of college(s)

Were you in good academic standing at the time you left the above college? ☐ Yes ☐ No

If no, explain

Are you presently employed full-time as a teacher? ☐ Yes ☐ No ☐ Elementary ☐ Secondary

If yes, give name and address of school and school system

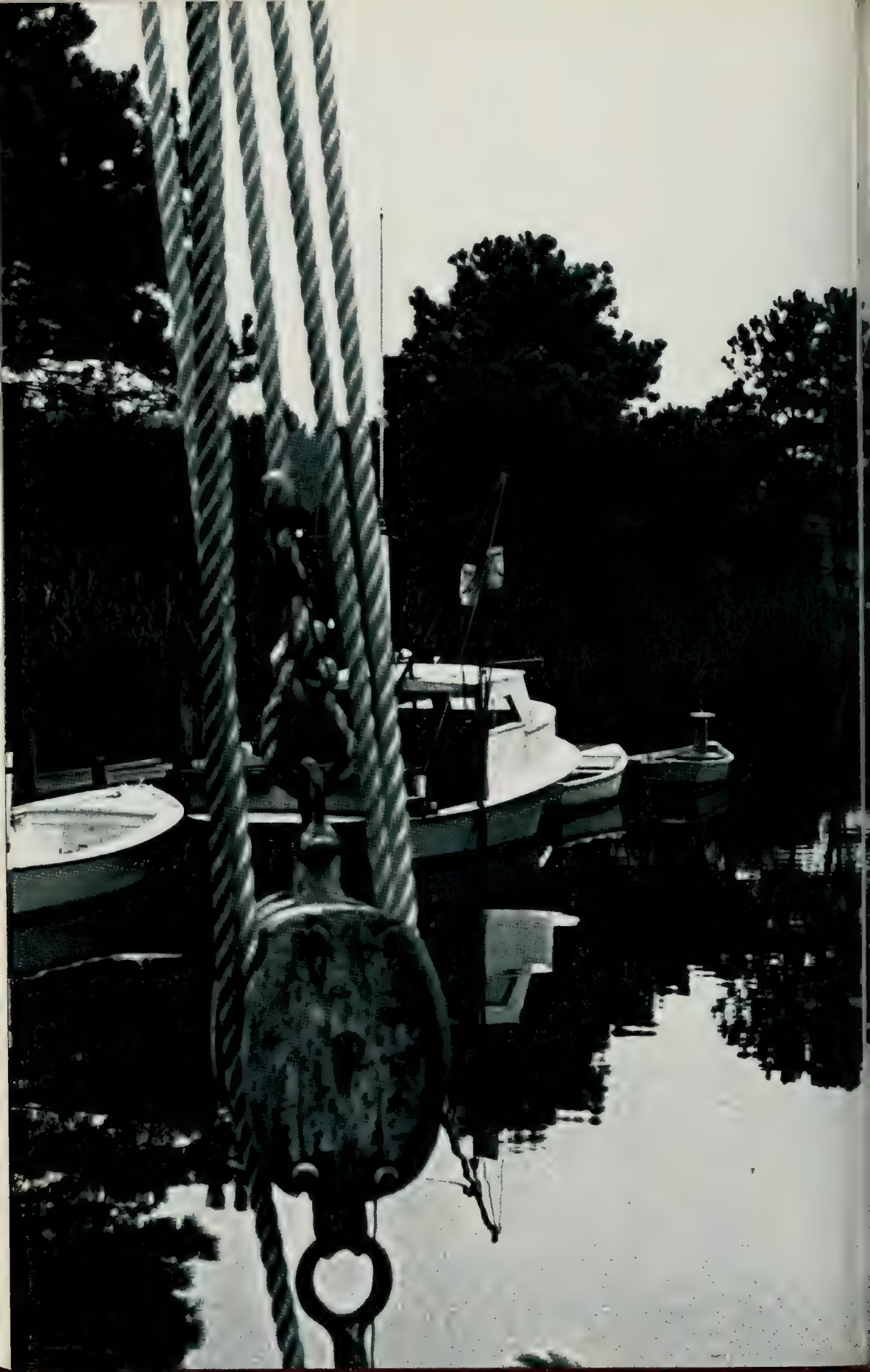
If you wish credit certified to some agency or school, transcripts may be obtained from the Office of the Registrar, 103 Allen Building, Duke University, Durham, North Carolina 27706.

Signature

Mail to: Director of the Summer Session, 120 Allen Building, Duke University, Durham, North Carolina 27706.

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Duke University
1979
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Marine Laboratory



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COVER DESIGN
Donna S. Slade

Typesetting by Electronic Composition, Inc., Washington, D.C.
Printed by Greensboro Printing Company, Greensboro, N.C.

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University Administration

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Robert N. Sawyer, Ed.D., *University Educational Planning Officer and Director of Summer Educational Programs*

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John P. Sutherland, *Acting Director, Director of Graduate Student Affairs, and Associate Professor of Zoology*

²Richard T. Barber, *Director of Cooperative Program in Biological Oceanography, Coordinator, Coastal Upwelling Ecosystems Analysis; and Associate Professor of Zoology and Botany*

Orrin H. Pilkey, *Acting Director of Cooperative Program in Biological Oceanography, Coordinator, Coastal Upwelling Ecosystems Analysis; and Professor of Geology*

Joseph Bonaventura, *Director of the Duke University Marine Biomedical Center and Assistant Medical Research Professor of Biochemistry*

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Michael P. Bradley, *Business Manager*

Norris A. Hill, *Maintenance Supervisor*

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Richard T. Barber, Ph.D., *Biological oceanography*

Celia Bonaventura, Ph.D., *Protein structure and function*

Joseph Bonaventura, Ph.D., *Protein structure and function*

¹On sabbatical 14 July 1978 - 14 January 1979

²On sabbatical 1 January 1978 - 31 December 1978

C. G. Bookhout, Ph.D., Marine invertebrate embryology and invertebrate zoology
 * Ralph Cavaliere, Ph.D., Marine microbiology
 * Norman L. Christensen, Ph.D., Plant ecology
 John D. Costlow, Ph.D., Marine invertebrate embryology and experimental zoology
 Richard B. Forward, Ph.D., Physiological ecology of marine animals
 * J. Douglas Glaeser, Ph.D., Geological oceanography
 * Paul J. Godfrey, Ph.D., Barrier beach migration
 Robert M. Goll, Ph.D., Distribution of living radiolaria
 I. E. Gray, Ph.D., *Professor Emeritus*, Marine ecology and entomology
 John Gutknecht, Ph.D., Membrane physiology
 William Kirby-Smith, Ph.D., Marine ecology
 * David McClay, Ph.D., Developmental biology
 * Orrin H. Pilkey, Ph.D., Geological oceanography
 Joseph S. Ramus, Ph.D., Photosynthetic physiology of marine plants
 * Bruce Rosendahl, Ph.D., Plate tectonics
 * Richard B. Searles, Ph.D., Marine phycology
 * Raymond Seed, Ph.D., Marine invertebrate zoology
 * Sharon Smith, Ph.D., Biological oceanography
 J. Bolling Sullivan, Ph.D., Comparative and evolutionary biochemistry
 John P. Sutherland, Ph.D., Marine ecology
 * Richard A. White, Ph.D., Plant diversity
 Adam Zsolnay, Ph.D., Chemical oceanography and marine geochemistry

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Ellen Jones, Maintenance Secretary

Vera Jordan, Receptionist/Switchboard
Operator

Lilian Lorenzsonn, Academic Coordinator

Sophia Turnage, Junior Buyer

Jean Williams, Senior Library Assistant

Mamre Wilson, Administrative Secretary

Technical Support Staff

James Chadwick, Light Equipment Operator

Claudia Davis, Housekeeper

Clifton Davis, Senior Plumber

Annie Fulford, Housekeeper

Donald Gagnon, Painter

Catherine Gibbs, Housekeeper

Doris Godette, Housekeeper

Eunice Godette, Housekeeper

Philip Golden, Plumber

Horace Holland, Mechanic

Grayden Moore, Carpenter

Tommy Morton, Head Cook

Sylvester Murray, Cook

Mildred Tyre, Housekeeper

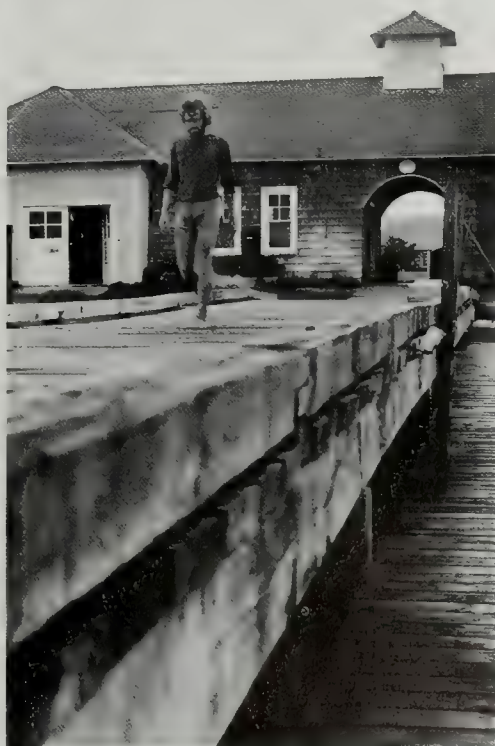
* Summer only.



Duke University Marine Laboratory Calendar—1979

January	Undergraduate Spring Term Program in the Marine Sciences	8 January–27 April
April	International Training Program in the Marine Sciences	2 April–31 May
	Cooperative Undergraduate Program in the Marine Sciences	late April–May
May	Summer Session Program, Term I	8 May–8 June
June	Summer Session Program, Term II	11 June–13 July
July	Summer Session Program, Term III	16 July–17 August
September	Electron Microscopy Institute	3–14 September





General Information



The Laboratory

Through the efforts of Dr. A. S. Pearse, the Duke University Marine Laboratory was founded in 1938 on Pivers Island near the town of Beaufort, North Carolina. Studies are currently being conducted there in the fields of ecology, systematics, physiology, embryology, mycology, algology, and biological, chemical, geological, and physical oceanography. In addition to the graduate program, an interdisciplinary program in the marine sciences makes it possible for qualified undergraduates to spend the spring semester at the laboratory.

The Duke University Marine Laboratory presently occupies fifteen acres of the southern portion of Pivers Island; the U.S. Department of Commerce, NOAA, National Marine Fisheries Service, and the Center for Menhaden Research are located on the remainder of the island.

The physical plant consists of twenty-four buildings including five dormitories, a large dining hall, one residence, boathouse, storehouse for ship's gear, classroom laboratories, seven research buildings, and a maintenance complex. The research laboratories and five dormitories are heated, and three dormitories are air-conditioned, thereby providing favorable conditions for year-round research.

Pivers Island is only 150 yards across the channel from the town of Beaufort. A bridge leads to U.S. Highway 70, so that the island is readily accessible by automobile. Transportation to the laboratory consists of bus service to Beaufort and Piedmont Airlines to New Bern, forty miles from Beaufort.

The Beaufort area is well known for its moderate climate during the summer. Air temperatures range from an average minimum of 70°F. to an average maximum of 86°F. There is a prevailing southwest breeze from the ocean during most of the summer. Water temperatures range from 22–29°C. in June and from 24–30°C. during August.

Students should bring clothes suitable for field work including a sun hat, tennis shoes, bathing suit, shorts, work gloves, and sunglasses.

There are ample opportunities for recreation in and around Beaufort for swimming, fishing, boating, and water-skiing. On campus there are recreational facilities for swimming, rowing, sailing, shuffleboard, volleyball, croquet, and table tennis.

Courses of Instruction



Spring Semester—Undergraduate Program

8 January–27 April 1979

The semester program consists of the courses listed below. A student may apply during the spring to continue study at the Marine Laboratory during the summer either by participating in senior-graduate courses or by continuing the independent studies initiated during the spring term.

Homo Sapiens and the Marine Environment. (Interdisciplinary Course 104.) Economic, legal, medical, political, social, and scientific viewpoints on the extent to which modern society has affected the marine environment, with special emphasis on problems of coastal North Carolina. Lectures and laboratories. Prerequisite: consent of instructor and director of undergraduate studies of student's major department. One course. *Costlow and staff*

Adaptations of Organisms to the Marine Environment. (Biochemistry 220L.) An introduction to basic concepts of biochemistry and to variables in the marine environment which evoke adaptive responses. Specific adaptations at the molecular level. Biological fitness from a biochemical viewpoint. Prerequisites: introductory biology, organic chemistry, and consent of instructors. (Class size limited to 16 students.) One course. *C. Bonaventura or J. Bonaventura*

Ecological Oceanography. (Botany 169L, Geology 169, or Zoology 169L.) Dynamics of marine communities in the context of current ecological theory. Life history strategies, competition, predation, diversity, and stability, followed by detailed considerations of both benthic and pelagic communities. Students may not receive credit for both Zoology 103L and 169L. Prerequisites: introductory biology and mathematics. One course. *Sutherland*

Physiology of Marine Animals. (Zoology 150L.) Comparative physiology including ecological and behavioral adaptations. Students may not receive credit for both Zoology 150L and 250L. Prerequisites: introductory biology and Chemistry 12. One course. *Forward*

Phytoplankton. (Botany 215L.) Identification, taxonomy, morphology, growth, seasonal succession, vertical distribution, and migration of marine phytoplankton. Laboratory and field exercises. Prerequisite: introductory biology. One course (4 graduate units). *Ramus*

Seminar. (Zoology 296S.) Recent research in the biochemistry and genetics of marine organisms: enzymes, evolution, and ecological strategies. Half-course.



Sullivan. (Zoology 296S.) Man's impact on biogeochemical cycles. Half-course.
Barber. (Zoology 296S.) Beach and island geological processes: study of the processes that affect the evolution of beaches and barrier islands with emphasis on how they affect man-made structures. Half-course. *Pilkey and staff*

Independent Study. (Botany, Geology, or Zoology 192.) For seniors and juniors with consent of the director of undergraduate studies and the supervising instructor. One and one-half courses. *Staff*

Spring Semester Graduate Program

Seminar. (Biochemistry, Botany, Geology, Physiology, or Zoology.) Special topics in the marine sciences. Exploration at the advanced level of current research in the marine sciences. Subject dependent on faculty and student interest. 2 units. *Staff*

Spring Semester—Other Programs

INTERNATIONAL TRAINING PROGRAM IN THE MARINE SCIENCES

April–May

Through a grant from the Rockefeller Foundation and UNESCO (United Nations Educational, Scientific, and Cultural Organization), Duke University Marine Laboratory offers an eight-week interdisciplinary program in the marine sciences centering on the relationship of marine animals to the estuarine, shelf, and oceanic environments and the way in which organisms have been adapted to specific physical, chemical, geological, and biological factors within these diverse environments. The program offers an opportunity to members of underdeveloped nations to participate in a schedule which includes lectures by resident and visiting scientists, field trips within the adjacent estuarine and shelf areas, and laboratory

exercises designed to present not only modern concepts and techniques, but also to demonstrate the importance of relating laboratory experiments to field observations under natural conditions. A major portion of the program involves an individual research project supervised by staff members of the Marine Laboratory, special discussion groups dealing with specific topics, and a series of seminars and lectures dealing with the effect of man's intervention on the estuarine and marine environments.

COOPERATIVE UNDERGRADUATE PROGRAM IN THE MARINE SCIENCES

April–May

During the late spring (late April to May), the Duke University Marine Laboratory offers an intensive five-week program on the marine environment to selected students from institutions which have no direct access to marine laboratory facilities and which are members of an informal consortium.

Lectures in the program cover the physical, chemical, geological, and biological aspects of the marine environment with emphasis on the ecology of marine organisms. Numerous field trips are made to estuarine and near-shore habitats which involve environmental measurements, identification of plants and animals collected, and discussion with emphasis on morphological, physiological, and ecological adaptations to the particular habitat. Live animals are used in laboratory experiments on physiology and behavior aimed at an understanding of the functioning of animals and their natural environment. Students read original research papers, give oral reports on relevant topics, and submit written reports on laboratory and field work. In addition to program work, the students will have the opportunity to meet resident staff and graduate students at the laboratory and discuss current research in marine science.

Calendar for Summer Session

Term I begins—8 May
Term II begins—11 June
Term III begins—16 July

Term I ends—8 June
Term II ends—13 July
Term III ends—17 August

First Summer Term

8 May–8 June 1979

Independent Study. (Botany, Geology, or Zoology 191.) For senior and junior majors with permission of the appropriate director of undergraduate studies and the supervising instructor. Course credit to be arranged. *Staff*

Introduction to Biological Oceanography. (Zoology 114L.) Physical, chemical, and biological processes of the oceans, emphasizing special adaptations for life in the sea and factors controlling distribution and abundance of organisms. Not open to students who have had Geology 53 or Botany 53. Prerequisite: introductory biology. One and one-half courses. *Staff (visiting summer faculty)*

Marine Invertebrate Zoology. (Zoology 176L.) Lectures, reading, and laboratory emphasizing examples of major marine phyla and classes collected from estuarine and marine habitats. Not open to students who have had Zoology 175, 274, or 275. Prerequisite: introductory biology. One and one-half courses. *Bookhout*



Plant Ecology. (Botany 147L/247L.) Principles of the relationships between plants and their environments. Structures and processes of ecosystems. Laboratory, lectures, and field trips. Prerequisites: introductory biology and one other course in biology. One and one-half courses (6 graduate units). *Christensen*

Research. (Zoology 353.) Hours to be arranged. Prior approval of instructor at the Duke University Marine Laboratory required. (For graduate students only.) *Staff*

Research. (Botany 359.) Individual investigation in the various fields of botany. Credit to be arranged. (For graduate students only.) *Staff*

Second Summer Term

11 June—13 July 1979

Independent Study. (Botany, Geology, or Zoology 192.) For senior and junior majors with permission of the appropriate director of undergraduate studies and the supervising instructor. Course credit to be arranged. *Staff*

Marine Ecology. (Zoology 203L.) Application of ecological theory to marine systems. Mathematical properties of population growth and species interactions; field and laboratory projects with computer-assisted analysis of data. Practice in scientific writing. Readings from current scientific publications. Prerequisites:

introductory biology or invertebrate zoology, and calculus. Knowledge of statistics helpful. One and one-half courses (6 graduate units). *Sutherland*

Physiological Ecology of Marine Animals. (Zoology 250L.) The physiology of marine animals as related to environmental factors of temperature, salinity, oxygen, and light. Prerequisite: a course in physiology. One and one-half courses (6 graduate units). *Forward*

Marine Phycology. (Botany 211.) Introduction to marine algae, systematics, morphology, physiology, and ecology. Field trips, laboratory, and lectures. One and one-half courses (6 graduate units). *Searles*

Comparative and Evolutionary Biochemistry. (Biochemistry 276.) Lectures and discussion of the origin of life, evolution of the genetic code, mutation and protein polymorphism, natural selection and protein structure, and comparison of homologous proteins and nucleic acids. Laboratory work involves the purification and characterization of homologous proteins from fish and invertebrates; salt fractionation, electrophoresis, ion-exchange and molecular exclusion chromatography, fingerprinting, molecular weight determination, amino acid composition, and other related approaches. Prerequisite: consent of the instructor. One and one-half courses (6 graduate units). *Sullivan*

Barrier Island Ecology. (Botany 218 or Environmental Studies 218.) Adaptation of plants to barrier island migration and other physical characteristics of the coastal environment. Major emphasis will be placed on management of barrier beaches from Maine to Texas and the impact of human interference with natural processes. Field studies. Prerequisite: course in general ecology. One and one-half courses (6 graduate units). *Godfrey (visiting summer faculty)*

Biological Oceanography. (Zoology 214L.) Impact of biological processes on the physical and chemical character of the environment and the regulating role of abiotic processes on organic productivity. Factors regulating primary and secondary productivity with the estuary and ocean as examples. Emphasis on the design and execution of directed research. Prerequisite: consent of instructor, introductory biological or chemical oceanography recommended. One and one-half courses (6 graduate units). *Barber*

Geological Oceanography. (Geology 205.) Broad geological aspects of the ocean basins including origin, bottom physiography, sediment distribution, submarine sedimentary processes, and shoreline processes. Field observations; sampling procedures. Not open to students who have completed Geology 206. One and one-half courses (6 graduate units). *Glaeser and Pilkey*

Research. (Zoology 354.) Hours to be arranged. Prior approval of instructor at the Duke University Marine Laboratory required. (For graduate students only.) *Staff*

Research. (Botany 360.) Individual investigation in the various fields of botany. Credit to be arranged. (For graduate students only.) *Staff*

Third Summer Term

16 July—17 August 1979

Independent Study. (Botany, Geology, or Zoology 191.) For senior and junior majors with permission of the appropriate director of undergraduate studies and the supervising instructor. Course credit to be arranged. *Staff*

Invertebrate Embryology. (Zoology 278.) Lectures, readings, and laboratory work dealing with rearing, development, and life history of invertebrates. Prerequisite: consent of the instructor. One and one-half courses (6 graduate units). *McClay*

Membrane Physiology and Osmoregulation. (Physiology 212.) Physiology of marine and estuarine organisms, with emphasis on cellular transport processes and electrophysiology. The course also includes the functions, mechanisms, and comparative aspects of ionic and osmotic regulation in plants and animals. Laboratory work deals with membrane transport in single cells and epithelia, renal and gill transport in fish, amino acid transport and metabolism in crustaceans, and application of radiotracer and other physical and chemical techniques to the study of membrane function. Prerequisite: consent of instructor. One and one-half courses (6 graduate units). *Gutknecht*

Marine Invertebrate Zoology. (Zoology 274L.) Structures, functions, and habits of invertebrate animals under natural and experimental conditions. Field trips included. Not open to undergraduate students who have had Zoology 175 except with consent of the director of undergraduate studies. Prerequisite: introductory biology. One and one-half courses (6 graduate units). *Seed (visiting summer faculty)*

Introduction to Marine Geophysics. (Geology 250.) Topics include seismic reflection and refraction, magnetics, gravity, and seismology. Prerequisite: introductory physics or consent of instructor. One and one-half courses (6 graduate units). *Rosendahl*

Photosynthetic Physiology of Marine Plants. (Botany 216L.) Variations in photosynthetic mechanisms and their ecological consequences in seaweeds and seagrasses. Topics include light capture, carbon reduction pathways, carbon allocation, dark respiration, photorespiration, growth strategies, and competitive interaction. Analytical methodologies used in laboratory and field exercises. Prerequisites: introductory biology, organic chemistry, and physics; or consent of instructor. One and one-half courses (6 graduate units). *Ramus*

Marine Microbiology. (Botany 204L.) The major groups of marine microorganisms, their taxonomy, culture, physiology, and ecology. Prerequisite: a course in introductory biology or botany. One and one-half courses (6 graduate units). *Cavaliere (visiting summer faculty)*

Research. (Zoology 353.) Hours to be arranged. Prior approval of instructor at the Duke University Marine Laboratory is required. (For graduate students only.) *Staff*

Research. (Botany 359.) Individual investigation in the various fields of botany. Credit to be arranged. (For graduate students only.) *Staff*

Fall Semester Graduate Program

The fall program consists of weekly seminars in which graduate students and staff who are resident at the laboratory meet to discuss their current research. In addition a number of symposia are held in which the entire Duke University community within a given discipline is invited. These symposia last three days and provide an opportunity for the exchange of information and ideas between graduate students and staff. Possible disciplines include biochemistry, botany, ecology, zoology, physiology, and geology, depending upon the interest in any given year. The facilities of the Marine Laboratory lend themselves to these symposia because of the presence of dormitories and a suitable auditorium.

Electron Microscopy Institute

The program is designed primarily to serve postdoctoral investigators whose work could be advanced by study of cell surfaces and cellular ultrastructure at very high magnification, or by X-ray microanalysis. Strongly recommended doctoral candidates and research technicians are also welcome to apply. No knowledge of the techniques of electron microscopy is assumed. The basic preparatory techniques will be demonstrated by the staff and then practiced by the participants, each of whom will gain practical experience in the basic techniques of TEM and SEM, including tissue fixation, embedding, ultramicrotomy, preparation of support films for particulates, operation of different makes of TEM, critical point drying, carbon and heavy metal coating, and operation of different makes of SEM. Freeze-fracture/freeze-etch techniques, as well as X-ray microanalytical techniques, will be demonstrated and may be practiced by interested participants. Instruction will be given in darkroom work and in the interpretation of the finished micrograph.

Because of the concentrated nature of the course, research projects by individual participants cannot be fitted into the program but members of the staff will be happy to discuss research problems during the discussion periods held after the lectures.



Admissions



Requirements and Procedures

All students applying to the Duke Marine Laboratory should complete the appropriate application form at the back of this bulletin and submit a transcript of their grades. Applicants will be considered without regard to race, color, religion, sex, handicap, or national origin. Students desiring a transfer of credit to their home institutions should request a course approval form for transfer of credit from the Admissions Office, Duke University Marine Laboratory, Beaufort, North Carolina 28516.

Spring Semester. An interdisciplinary program in the marine sciences is offered at the Duke Marine Laboratory for the spring semester. The program is open to qualified juniors and seniors from Duke and other colleges and universities. The full semester program for each student consists of two courses, one or two seminars, and independent study. Applications are to be submitted by 6 October to Admissions, Duke University Marine Laboratory. Each applicant is required to submit two letters of recommendation, one of which must be from the director of undergraduate studies, or the equivalent, from the student's major department, and a current academic transcript. Students will be notified of the action of the Admission Committee prior to registration for the spring semester.

Duke University students are given preference in admission if judged equal to other applicants in academic preparation and general potential for making maximum use of the opportunities afforded by residence at the laboratory. (The application form is in the back of this bulletin.)

Summer Terms. Introductory (100-level) courses offered at the laboratory during the summer are intended for undergraduate students from the sophomore to the senior level. All other courses (200-level) offered at the laboratory during the summer are intended for graduate students and senior undergraduate students. Applications should be submitted to Admissions, Duke University Marine Laboratory as early as possible to allow for adequate processing time and to assure a space in the desired course. Late applicants will be admitted if space permits. After acceptance, payment of deposit is essential to ensure reservation in a course.

Students wishing to apply summer credits toward an advanced degree at Duke University must, in addition to filling in the application blank, register with the Duke University Graduate School. Students who have had adequate preparation and approval of their major professor may request space for independent or thesis research.

For a schedule of concurrent summer courses taught at the University of North Carolina Institute of Marine Sciences in Morehead City, North Carolina, write: Director, Marine Sciences Program, University of North Carolina, 12-5 Venable Hall, Chapel Hill, North Carolina 27514.

Financial Information



Summer Terms

Deposit. Upon acceptance into a course, a deposit of \$20 is required to ensure a reservation in that course.

Tuition and Fees. The following are tuition charges for summer registration:

1. Undergraduate students: \$330 for each nonlaboratory course; \$440 for each undergraduate laboratory course; and \$660 for each one and one-half course (6 unit) program offered at the Duke University Marine Laboratory.
2. Graduate students: \$110 per unit. For an undergraduate course, the tuition rate indicated in section 1 above is applicable.
3. Full-time elementary, secondary school, and neighboring college teachers may be eligible for one-half of the tuition charge specified in sections 1 and 2 above. *Exceptions:* Teachers pursuing a doctoral program (post-master's) at Duke, or those on leave of absence from their schools or not currently employed are not eligible for this special tuition fee.

The director of the Duke University Marine Laboratory will notify the applicant of course approval. Tuition should be paid promptly to the Business Office, Duke University Marine Laboratory, Beaufort, North Carolina 28516.

Student Health. The costs of student health benefits have been borne by tuition in the past, but are now separate and can be identified as a medical expense for tax purposes.

All regular full-time undergraduate students (those registered for three courses or more) and all regular full-time graduate and professional students (those registered for 9 units or more and for 3 units if the preliminary examination has been passed) are required to pay the health fee that is nonrefundable after the first day of classes in the semester. In addition, all summer session students are required to pay a student health fee for each summer term. Graduate students, registered for summer research but not taking summer term courses, are required to pay an inclusive summer student health fee. The only exceptions to this requirement are for the following reasons: (1) if covered by a spouse's or parents' Duke University employee Blue Cross-Blue Shield insurance or (2) if eligible for and elect to use the V.A. Hospital services.

Room and Board. Air-conditioned and a few non-air-conditioned dormitory rooms are available. Although every effort is made to have only two people per dormitory room, a few triple rooms may be needed to accommodate all individuals requiring dormitory space. Prospective students should indicate their preference



ror housing on the application for enrollment. It is impossible to guarantee that these preferences will be available in all cases.

Occupants must supply their own linens, blankets, and towels, but pillows will be furnished. A key deposit of \$5 will be charged each person occupying a dormitory room. This deposit will be refunded at time of departure.

Full board provides for three meals a day, Monday through Saturday, and breakfast and noon dinner on Sunday. There will be no credit allowed for missed meals. Total fees for room and board will range between \$310 and \$335 per term depending upon the dormitory room assignment.

Estimated Term Costs. Estimated cost for each of the summer terms will be: tuition—(see tuition section); student health fee—\$18.50; and room and board—\$310 to \$335. Books, if required by the instructor, will be available at registration.

Spring Term

Tuition. Tuition for the spring term will be \$1,915 payable either at registration or by mailing a check to the Business Office, Duke University Marine Laboratory, Beaufort, North Carolina 28516 upon acceptance for the term.

Student Health. (See information in the section on Summer Terms.)

Room and Board. All dormitory occupants must supply their own linens, blankets, and towels, but pillows will be furnished. A key deposit of \$5 will be charged each person occupying a room. This deposit will be refunded at time of departure.

Full board provides for three meals a day, Monday through Saturday, and breakfast and dinner on Sunday. No credit will be allowed for meals that are missed. Total room and board fee will be \$921 for the term.

Estimated Term Costs. Estimated costs for the spring term will be: tuition—\$1,915; student health—\$53.50; room and board—\$921. Books, if required by the instructor, will be available at registration.

Late Registration

Late registration fees will be charged in accordance with Duke University policy unless registration is completed and all fees paid by noon of the first day of classes of the term.

Refunds

Refund for Tuition and Fees. Tuition and fees will be refunded under the following circumstances:

1. When notifications of withdrawal are received by the director of the Duke University Marine Laboratory before the first class day of a given term of the summer session, full tuition and fees will be refunded.
2. When applications for withdrawal are received by the summer session office at the Marine Laboratory during the first four class days of a given term, 80 percent of the tuition and fees will be refunded.
3. When applications for withdrawal are received by the summer session office at the Marine Laboratory after the fourth class day, there will be no refund of tuition and fees.



Other Financial Information

Room and Board Costs. All Duke University Marine Laboratory visitors who stay on the island will pay a room and board fee of \$11.50 per day. Allowances will be made for partial days' stay and to permit an occasional evening meal at local restaurants.

Boat Rentals. The following boats are available at the laboratory for collecting and instructional activities. Charges apply to all research activities and all non-Duke University teaching activities.

Boat Type	Name	Charges
62 ft. steel oceanographic research vessel	<i>John de Wolf II</i> *	\$800 per day
55 ft. trawler	<i>Beveridge</i> *	\$29.00 per hour
39 ft. cabin diesel powered	<i>Venus</i> *	\$20.00 per hour
22.1 ft. open boat	<i>Ocyrode</i>	\$15.00 per hour
Boston Whaler		\$7.00 per hour
Skiffs with outboard motors		\$4.00 per hour

*Crew required for safety of user and vessel

These rates are intended to defray partially the cost of operating and maintaining these boats.

Most of these boats may be scheduled by visiting researchers through the maintenance office; however, first priority must be given to classes when they are in session during the spring and summer terms. Use of Duke University Marine Laboratory vessels for any sponsored research will be subject to charges.

Crew Overtime. If crew overtime is involved before or after a normal work day and any time Saturday or Sunday, the following charges will apply from 1 July 1978, to 30 June 1979: master, \$8.75 per hour; winch operator, \$7.25 per hour. An additional \$4 per person per hour will be charged for overtime on Duke University holidays.

Research Space. Research space, including seawater tables, is available on a limited basis for Duke University Marine Laboratory visitors. Research space rent for all users is \$1 per square foot per month. Typical size of laboratory-office area is 100 square feet. Requests for laboratory space, office space, and/or seawater tables should be sent to the Business Office, Duke University Marine Laboratory, Beaufort, North Carolina 28516.

Teaching Space. Various size classrooms are available from September through April of each year. Cost for such space is 50¢ per day per student. Requests for these teaching areas, including class needs such as seawater tables, collecting equipment, etc., should be sent to the Business Office, Duke University Marine Laboratory, Beaufort, North Carolina 28516.

Check Cashing. The banks in the Morehead City-Beaufort area have indicated that they will not cash personal checks for students unless they are guaranteed. Therefore, it is recommended that students who come to the laboratory bring with them sufficient travelers' checks, money orders, certified checks (which the banks will cash), or cash to cover expenses.

Financial Assistance

Teaching Assistantships. Five graduate student teaching assistantships will be available during the period of 1 January through 31 August 1980. Students registered in a graduate program in any department in the sciences at Duke University may apply. Recipients must be in residence at Beaufort during the period of their appointment and also conduct, or plan to conduct, their research at the Duke University Marine Laboratory in Beaufort.

Applications must be received by the director of graduate student affairs before 31 January 1979. Applicants will be judged on the basis of need, qualifications for the courses in which they will assist, and previous teaching and graduate experience. A student may receive a maximum of three years' support under this program.

For further information, write the Director of Graduate Student Affairs, Duke University Marine Laboratory, Beaufort, North Carolina 28516.

Deborah Susan Steer Memorial Scholarship Fund in Marine Life-Sciences. Each year the income from this fund will be used to provide financial assistance to promising Duke undergraduates who wish to study marine life-sciences at the Duke University Marine Laboratory. Priority will be given to students in the summer session. Interested students should write to Admissions, Duke University Marine Laboratory, Beaufort, North Carolina 28516.

Policy of Nondiscrimination

Duke University does not discriminate on the basis of age, race, color, national and ethnic origin, sex, or handicap, in the administration of educational policies, admission policies, financial aid, employment, or any other University program or activity. Inquiries concerning the University's responsibility may be directed to the director of equal opportunity.

Resources for Study and Research



Flora and Fauna

Beaufort is located on the North Carolina coast, adjacent to the new Cape Lookout National Seashore Park, in an area within the range of both the northern and southern species of biota. The edge of the Gulf Stream system is about thirty-five miles offshore, and between it and the shore occasional reefs are found.

The Beaufort area is strategically located for biological research because of the richness of its flora and fauna, and the ease with which one may reach many diverse habitats. From the laboratory, by boat or automobile, the Atlantic Ocean, Cape Lookout and the Outer Banks, Bogue and Core Sounds, Harkers Island, rivers, creeks, canals, mud flats, sand beaches, dunes, marshes, peat bogs, cypress swamps, bird islands and rookeries, and coastal forests are readily accessible. Long leaf pine, yaupon, and at least seven species of insectivorous plants (protected by law), including the Venus flytrap, grow in the region. A great variety of algae, both fresh water and marine, is also available for study. Common animals include the blue crab, squid, shrimps, snails, clams, ctenophores, jellyfish, hydroids, sponges, polychaetes, sea urchins, starfish, brittle stars, sand dollars, skimmers, terns, gulls, herons, sea turtles, porpoises, and many different types of fish.

Research Interests

Much of the early research at the Marine Laboratory consisted of determining the distribution of plants and animals within the varying environments of the Beaufort estuary. With the addition of the Cooperative Oceanographic Program and the expansion of year-round activities, the general theme of the relationships of animals and plants to their environment has been broadened to include all segments of the estuarine and oceanic environments. Year-round research by resident staff, associates, visiting staff, and graduate students generally falls into seven broad disciplines: environmental health, biochemistry, botany, developmental biology, oceanography, physiology, and systematics-ecology.

Environmental Health. The marine environment and processes of marine systems bear a direct relationship to problems of environmental health. Marine systems are particularly useful as models for specific terrestrial environmental processes. The National Institutes of Health has recently established a Marine Biomedical Center at the Duke University Marine Laboratory. This center encourages productive interactions between established investigators at Beaufort and in Durham who have expertise in various aspects of medical and marine

sciences. The research goal of the Duke University Marine Biomedical Center is to gain a better understanding of the mechanisms involved in the adaptation of man and other organisms to an environment that is both hostile and continually changing. Emphasis is placed on the biochemical and biological impact of metal and nonmetal pollutants.

Biochemistry. The primary emphasis in the biochemical studies involves research on the structure, function, and evolution of protein molecules. Proteins, especially those involved in the transport of molecular oxygen (hemoglobin, hemocyanin, chlorocruorin, and hemerythrin), are being isolated and their structural and functional properties elucidated. These studies are intended to illustrate how protein molecules function, as well as how they have evolved. A major interest is how proteins are involved in adaptive processes. From comparative studies one can illuminate structure-function relationships and derive data on phylogenetic significance. Studies of protein polymorphisms are intended to illustrate gene flow among populations and offer insights into the adaptive strategies of marine organisms.

Botany. The seaweeds are the primary focus of current botanical studies although the terrestrial maritime vegetation of the Outer Banks and coastal plain has been the subject of many recent investigations. Research on the seaweeds includes taxonomic, ecological, and physiological projects. Taxonomic work is concentrated on the algae of the offshore waters where ecological studies of community structure and plant and animal interactions are also being conducted. Investigations of algal physiology and physiological ecology are focused on the ecological significance of photosynthetic adaptations and growth strategy as they relate to coexisting fugitive seaweed species. Metabolic controlled allocation of photosynthetically reduced carbon in unicellular red algae is also under study.

Developmental Biology. Much of the research in developmental biology deals with the culture of invertebrate larvae under controlled conditions in the laboratory, from hatching until the juvenile stages are reached. The availability of numerous larvae of known species, age, and stage of development has led to studies on the extent to which environmental factors within the marine environment affect rates of development, survival, and morphological abnormalities. In addition to studying the effects of natural environmental factors, research is under way to determine the effects of pollutants on larval development of marine crustacea. The developmental biology program also includes studies on the physiology of crustacean larvae and the factors involved in regulation of molting, rate of development, and metamorphosis during larval development.

Oceanography. During 1979 the Oceanographic Program will focus its research efforts on four major ocean basins: Western Mid-Atlantic, Western North Atlantic, Caribbean, and the East Central Pacific. There will be twenty-one cruises ranging in duration from four to nineteen days.

Investigations in the Western Mid-Atlantic will involve ecological studies of pelagic and deep-sea benthic communities, phytoplankton ecology, benthic carbon and nitrogen regeneration, carbonate geology, and a major emphasis on geological transitions from the ocean basin to the continent.

Investigations in the Western North Atlantic will include studies of demersal communities, phytoplankton populations, paleoceanography, and geological investigations of a seamount.

Investigations in the Caribbean are planned which involve studies of deep-sea microbial ecology and geophysical mapping.

The East Central Pacific cruises will focus on the propagation of equatorial disturbances, benthic community structure and function, and chemical investigations of benthic carbon and nitrogen cycles.

Physiology. In the realm of physiological studies, one primary interest involves studies on the photobiology of organisms in the marine environment, with emphasis on behavioral orientation to light. This involves determining the responses of a variety of marine organisms (unicellular dinoflagellates, larval crustaceans, and fish) to light, both in the natural environment as well as in the laboratory. Primary attention is on the identification of the light receptive pigments participating in the responses and the circadian rhythm of these responses. Accordingly, phototaxis is used as a model system for studying the basic physiology of rhythms.

A second area of interest is in membrane physiology and osmoregulation. The mechanisms and functions of salt and water transport in marine plants and animals are being studied. Specific interests include the mechanisms of osmotic regulation in giant algal cells and the role of the urinary bladder, gills, and gut in osmoregulation of fish. In conjunction with studies on marine plants and animals, research is also being conducted on the transport properties of synthetic lipid bilayer membranes. Specific interests include the effects of carbonic anhydrase on CO_2 transport, facilitated diffusion of salicylates and other drugs, and the effects of antidiuretic hormone, calcium, and membrane fluidity on water permeability of lipid bilayers.

Systematics-Ecology. Research in the Systematics-Ecology Program involves studies on community structure, benthic algae, and distribution of marine species off the North Carolina coast, and experimental phycology.

The major objective of the studies on community structure is to identify and understand the processes which result in the temporal and spatial patterns in species abundance in some subtidal, epibenthic communities. Changes in the adult populations are followed with mapping and photographic techniques. The approach is experimental to the extent that species can be removed or excluded from the community to assess their importance in community structure and function. An eventual goal is the development of a systems model incorporating the basic community processes to provide the basis for predicting the deliberate or accidental effects of man's perturbations of these communities. This work was initiated with estuarine animal populations. Comparable work is now being done on the plant and animal populations on the rocky substrates of the continental shelf.

As part of this continuing research program, a seawater laboratory has been constructed to investigate the influence of thermal addition on community structure and the physiological ecology of individual species.

In part because the middle Atlantic coast is a meeting ground for the cool water species typical of northern shores and the warm water species of the Caribbean, studies include the determination of the distribution, phenology, and systematics of benthic algae off the coast of North Carolina. This work includes efforts to determine community structure and productivity in the different portions of Onslow Bay and to extend the studies north and south along the entire coast.

Additional studies are being conducted to investigate the growth rates and development of suspension feeders in relation to temperature, size of the animals, concentration of suspended material, and the relative concentration of phytoplankton in suspension. These experiments involve natural seawater in a continuous flow system in which the concentration of phytoplankton can be monitored. The results suggest that the conditions under which maximum energy

transfer occurs between primary producers and a primary consumer facilitate the future exploitation of scallops, oysters, and other similar species.

The ramifications in estuarine waters of converting swamp-forests into intensive agriculture are being investigated as a large corporate farm develops near the Marine Laboratory. In addition to providing basic information on the functioning of an estuary which receives coastal swamp water, the results of the research are being used by farm management and regulatory agencies, and serve as a model for future decisions on agricultural/estuarine development.

Research Facilities

Laboratory Equipment and Supplies. Visiting investigators may obtain research space throughout the year. Each research laboratory building is air-conditioned and equipped with running seawater through a P.V.C. system. There are tanks, water tables, aquaria, autoclaves, ovens, and plant presses. In addition to commonly used laboratory equipment, the following are available: two refrigerated centrifuges with multispeed attachments, Beckman DU spectrophotometer, balances, pH meters, hoods, and constant temperature equipment. Students are expected to supply their own optical equipment or other special apparatus needed. A list of equipment, chemicals, and glassware may be obtained upon request. The laboratory also maintains darkrooms, a well-equipped workshop, and a stock room/purchasing department.

Research Facility. A three-story modern research laboratory, the Bookhout Research Laboratory, was completed early in the summer of 1972. Each room is well lighted artificially and all exterior rooms also receive natural light. Most rooms have a view of the water surrounding some part of Pivers Island. All rooms are air-conditioned and heated electrically so that the temperature of each room can be controlled to suit the needs of the occupant. Hot and cold water, air, gas, and vacuum are available in most rooms. The nonmetallic seawater system is especially designed to reduce silt and fouling. The general arrangement of rooms on each floor provides for a core of rooms in the center of the building which are for general use and research rooms of different sizes are at the periphery of the building. Although the rooms on all three floors were designed for special purposes, they may be used for research in a variety of disciplines.

Oceanographic Study. The 117.5-foot research vessel *Eastward* with a capacity for fourteen scientists may be used for oceanographic research. In 1979 the ship will operate in the Atlantic Ocean, doing work off the coast of the United States and in the Caribbean Sea. It is outfitted with modern recording and collecting devices and is available to investigators in the marine sciences. Application for ship time must be made in advance. Inquiries should be addressed to the Oceanographic Program Director, Duke University Marine Laboratory, Beaufort, North Carolina 28516.

In addition to the *Eastward*, the Marine Laboratory has a new research vessel, the *John de Wolf II*. This steel vessel is sixty-two feet long, has a nineteen and one-half foot beam, and draws nine feet of water. The vessel is being used for near-shore and offshore oceanographic research including hydrographic sampling and long-lining operations. In 1979 the *John de Wolf II* will be used by Duke, North Carolina State, University of North Carolina, and U.S. Coastal Geodetic Survey scientists for research and course-related teaching and training programs. The vessel sleeps a total of twelve persons, accommodating six to nine scientists depending upon the duration of the cruise. Applications for ship time must be made in advance. Inquiries should be addressed to the Coordinator, R/V *John de Wolf II*, Duke University Marine Laboratory, Beaufort, North Carolina 28516.

Collecting. Spades, shovels, sieves, and nets are provided without charge to assist investigators with their collecting. A wide assortment of boats is available for various collecting activities. A complete schedule of boats and charges may be found in the section on financial information. Information on species availability and collecting sites is available from the curator of the reference collection.

I. E. Gray Library-Auditorium. This facility is air-conditioned, electrically heated, and has stack space for 18,500 volumes on the first floor. A second floor is intended for future expansion. Located in the building are the librarian's office, a room for duplicating machines, a receiving room, a kitchenette, two seminar rooms, and two closed carrels.

The building houses the Pearse Memorial Library which contains 4,250 catalogued reference books and journals, 150 current journals, and 1,720 reprints. There are also expedition reports in oceanography, a microfilm library of graduate student theses based on research at the laboratory, a microfilm reader, and a Savin 755 copier. Other materials may be obtained by a special delivery system from the Perkins Library on the Durham campus or through the interlibrary loan service with other libraries in the United States.

The auditorium has a seating capacity of approximately 300 and is suitable for lectures, seminars, symposia, and small regional or national meetings.

Reference Collections. A reference collection of approximately 1,500 different species of animals from coastal North Carolina is available to students and research personnel. Small collections of marine algae and vascular flora are also maintained, as well as a checklist by habitat of the common marine animals.

Computing Facilities. The Duke University Marine Laboratory operates a Digital Equipment Corporation PDP-11/34 minicomputer for use by staff, students, and visiting investigators. The computer has 60K of memory and is generally operated under Multi-User BASIC, a programming language that can be mastered with a relatively short time commitment. The operating system has two disks, used for mass data storage and rapid access of files and data. A dual cassette system is also available that provides for permanent data storage. There are two graphics terminals and three hard-copy terminals, one of which serves as a high speed line printer.

Scanning Electron Microscope. It is anticipated that Philips Electronic Instruments, Inc. will again provide the Marine Laboratory with a Philips 501 SEM/EDAX system demonstration unit. This facility will be available to Duke University Marine Laboratory staff, students, visiting researchers, and area scientists throughout the summer. In addition to its function as a short-term teaching and research tool, this demonstration is intended to canvass potential users in anticipation of an eventual purchase.

Research Activities

Research Administration

Michael P. Bradley, Business Manager
Dianne Gagnon, Accounting Specialist, DUML Grant Activities
Linda J. Allred, Administrative Assistant, Coastal Upwelling Ecosystems Analysis
Sylvia Springle, Administrative Secretary/Accountant, Cooperative Oceanographic Program
Dorothy Johnson, Administrative Secretary, Cooperative Oceanographic Program
Jane Kogelschatz, Research Administrative Assistant, Coastal Upwelling Ecosystems Analysis
Linda Johnson, Secretary, Coastal Upwelling Ecosystems Analysis
Cindy Fowler, Staff Assistant, DUML Proposals
Janine Coleman, Clerk, Business Office

Resident Researchers

Dr. Richard T. Barber has been studying the effect of chemical properties of seawater on primary production. The experimental parameters are major and minor constituents, trace elements, dissolved gases, the carbon dioxide system, dissolved organic constituents, the nutrient systems and their biochemical and physiochemical aspects, and dynamic equilibria in the chemical systems of the marine environment. His research emphasis is on large scale oceanic upwelling systems and upper estuary (fresh water/salt water) interfaces.

Dr. Celia Bonaventura's work includes molecular controls of hemoglobin function. Comparative studies using respiratory proteins from marine organisms are being done to illustrate aspects of biochemical adaptation. Studies of cytochromes and cytochrome oxidases are also being conducted as well as studies on environmental biochemistry.

Dr. Joseph Bonaventura conducts research on the structure-function relationships in protein molecules, particularly those involved in transporting oxygen (hemoglobins, hemerythrins and hemocyanins). Much effort is devoted to understanding the molecular basis of adaptation in marine organisms. He is also working on sickle cell hemoglobin and other abnormal human hemoglobins and searching for chemical means of increasing oxygen delivery to tissues by altering intraerythrocytic oxygen affinity. Studies of cytochromes and cytochrome oxidases are also being conducted as well as studies on environmental biochemistry.

Dr. C. G. Bookhout is investigating effects of insecticides on the complete development of mud-crabs and blue crabs. He is also conducting a study of the development of the family of crabs to which the blue crab belongs.

Dr. Marius Brouwer's research focuses on characterization of the intermediates found in the assembly of the forty-eight-subunit aggregate of *Limulus* hemocyanin by means of ultra-centrifugation, oxygen equilibria, and kinetics. Allosteric models are also studied.

Dr. John Costlow studies the development of endocrine mechanisms in marine invertebrate larvae, the transitional phases during metamorphosis, and the relationship between endocrine mechanisms found in different marine animals. Studies are also being made of the structure and habits of living invertebrates, as well as their behavior under experimental conditions; ecology, physiology, and systematics of major constituents of zooplankton including vertical migration, seasonal variations, and zoogeography of zooplankton, as well as the embryological and larval processes in marine invertebrates, culture of marine invertebrates under controlled environmental conditions, physiology and biochemistry of invertebrate development.

Dr. Richard Forward is carrying out photobiology studies of marine animals and dinoflagellates with emphasis on relating the basic physiology to the ecology of the organism.

Dr. Robert Goll studies evolutionary processes in marine microzooplankton. Radiolaria, studied both biogeographically and paleontologically, are organisms of particular interest.

Dr. John Gutknecht is working on mechanisms and functions of ion transport across cell membranes. His experiments are done with giant algae cells, fish, and synthetic phospholipid bilayer membranes.

Dr. Susan Huntsman is working on phytoplankton nutrition and organometallic complexes in the sea.

Dr. Rudolfo Iturriaga conducts studies of phytoplankton extracellular metabolites and heterotrophic activity interactions.

Dr. William Kirby-Smith is investigating the effects of thermal additions on the development of fouling communities. He conducts studies on the water quality ramifications on estuaries of converting bordering forests to agricultural uses.

Research is also being done on biological problems involved in suspension feeding aquaculture systems with emphasis on the feeding physiology of bay scallops.

Dr. George Lapennas conducts investigations of compounds which irreversibly alter the oxygen affinity in intraerythrocytic hemoglobin and studies the secretion of gases into fish swimbladders.

Dr. Emilia Pandolfelli is studying the effect of steady-state light perturbation of carbon monoxide-hemoglobin complexes in order to assess the role of various kinetic parameters in the normal functional properties of hemoglobin.

Dr. Joseph Ramus conducts studies on algal physiology and ecological physiology: (1) The ecological significance of photosynthetic adaptations and growth strategy of coexisting fugitive seaweed species and (2) metabolic control of allocation of photosynthetically reduced carbon in the unicellular red alga *Porphyridium*.

Dr. Paul Rutledge is conducting studies of sickle cell hemoglobin and possible means of inhibiting the sickling process. Other studies include oxygen transport in arthropods.

Dr. J. Bolling Sullivan is doing biochemical studies of the evolutionary process, emphasizing the role of proteins as indicators of evolutionary events.

Dr. John Sutherland's research is on a variety of benthic marine communities involving the experimental analysis of the processes of competition and predation and their effect on community structure.

Dr. Ann Houston Williams works on experimental community ecology on the continental shelf.

Dr. Adam Zsolnay studies transfer of organics by colloidal material in the sea as well as phytoplankton exudates and their bacterial transformation.

Visiting Researchers

Barry Ache, Ph.D., Department of Biological Sciences, Florida Atlantic University. Crustacean chemoreception.

Anwar Abdel Aleem, D.Sc., Department of Oceanography, Faculty of Science, King Abdul Aziz University, Jeddah, Saudi Arabia. Benthic algae.

David Alexander, B.S., Department of Zoology, Duke University. Biomechanics of sand dollars.

Geoffrey Back, B.A., Kenyon College. Feeding and digestion in shipworms.

Peter Bebbington, Ph.D., Department of Science, Madeley College of Education, Madeley, Cheshire, England. Biosynthesis of molting hormones in barnacles.

Stewart Berlocher, Ph.D., Department of Entomology, University of Illinois at Urbana-Champaign. *Busyon* biochemistry.

Doris Bull, B.S., Department of Biology, The City College of the City University of New York. Fiddler crabs.

Diane Campbell, B.S., Department of Zoology, Duke University. Marine ecology.

Marit Christiansen, Ph.D., Zoological Museum, University of Oslo, Oslo, Norway. Salinity and temperature effects on crab larvae.

James Colacino, Ph.D., Department of Zoology, Clemson University. Sea cucumber hemoglobins. Oxygen transport and respiration.

Thomas Curtin, Ph.D., Department of Geosciences, North Carolina State University. Physical oceanography.

Robert Dean, Ph.D., Department of Biology, Kenyon College. Feeding and digestion in shipworms.

Ross Ellington, Ph.D., Department of Zoology, University of Vermont. Effects of cyclic thermal regimes on metabolism.

- J. Douglas Glaeser, Ph.D., Adjunct Associate Professor, Department of Geology, Duke University. Geological oceanography.
- Paul Godfrey, Ph.D., Department of Botany, University of Massachusetts. Barrier reef migration.
- Elizabeth M. Gosling, Ph.D., Population Genetics Laboratory, Zoology Department, University College, Galway, Ireland. Purification procedures; characterization in *Mytilus edulis*.
- Steven Gullans, B.S., Department of Physiology, Duke University. Membrane physiology.
- Herman Gutfreund, Ph.D., Department of Biochemistry, The Medical School, University of Bristol, Bristol, England. Enzyme kinetics.
- Ilpo J. Haahtela, Lic.Phil., Department of Biology, Zoology Section, Laboratory of Morphology and Ecology, University of Turku, Turku, Finland. Breeding biology and embryology of isopods.
- Pamela Harges, B.S., Department of Zoology, Duke University. Crustacean chemoreception.
- George Hughes, Ph.D., Department of Zoology, University of Bristol, Bristol, England. Respiration physiology.
- Atig Huni, Ph.D., University of Al-Fatah, Tripoli, Libya. Larval development in marine invertebrates.
- Gary Hyatt, Ph.D., University of Illinois at Chicago Circle. Fiddler crab sociobiology.
- William Jeffries, Ph.D., Department of Biology, Dickinson College. Larval stages of *Octolasmis mulleri*.
- Thomas Jegla, Ph.D., Department of Biology, Kenyon College. Molting in *Limulus* larvae.
- Lillian Koro, B.S., Department of Physiology, Duke University. Membrane physiology.
- Jean Lamy, Ph.D. and Josette Provansal Lamy, Ph.D., Department of Biochemistry, School of Medicine, University of Tours, Tours, France. Arthropod hemocyanin; structure-function relationships.
- Sandra Lane, Department of Biology, Kenyon College. Molting in *Limulus* larvae.
- Michele Leclerc, M.S., Department of Biochemistry, School of Medicine, University of Tours, Tours, France. Arthropod hemocyanin; structure-function relationships.
- Jeffrey Levinton, Ph.D., Department of Ecology and Evolution, State University of New York at Stony Brook. Genetics of physiological differentiation.
- Eve L. MacDonald, Ph.D., Department of Toxicology and Experimental Pathology, Burroughs-Wellcome Co. Electron microscopy.
- Charlotte Mangum, Ph.D., Department of Biology, College of William and Mary. Comparative physiology.
- Michael Manhart, B.A., Department of Biology, Kenyon College. Feeding and digestion in shipworms.
- Hans-Jurgen Markl, Ph.D., Institute of Zoology, University of Munich, Munich, Germany. Spider hemocyanin.
- David McClay, Ph.D., Department of Zoology, Duke University. Developmental biology.
- John Morrill, Ph.D., Department of Biology, University of South Florida. Electron microscopy.
- Genevieve G. Payen, Ph.D., Laboratory of Sexuality and Reproduction of Invertebrates, University of Pierre and Marie Curie, Paris, France. Effects of insecticides on morphogenesis.

- Andre Pequeux, Ph.D., Institute of Zoology, Laboratory of Animal Physiology, University of Liege, Liege, Belgium. Regulation of the osmotic effectors in the blood.
- Hermann Rahn, Ph.D., Department of Physiology, State University of New York at Buffalo. Water transport across bird eggs; environmental surveillance.
- Pier Giorgio Righetti, Ph.D., Department of Biochemistry, University of Milan and Adriana Bianchi-Bosisio Righetti, M.D., Department of Clinical Chemistry, Macedonio Melloni Hospital, Milan, Italy. Isoelectric focusing of high molecular weight proteins.
- Bruce Rosendahl, Ph.D., Department of Geology, Duke University. Plate tectonics.
- Gilbert Rowe, Ph.D., Woods Hole Oceanographic Institution. Biological oceanography.
- Paul Rutledge, Ph.D., University of Oregon. Sick cell hemoglobin and possible means of inhibiting the sickling process.
- Frank Schatzlein, Ph.D., California State University at Long Beach. Respiratory rates of crab larvae.
- Richard Searles, Ph.D., Department of Botany, Duke University. Marine phycology.
- Raymond Seed, Ph.D., Department of Zoology, University College of North Wales, Bangor, Gwynedd, Wales. Invertebrate zoology.
- Walker Smith, Ph.D., Program in Ecology, University of Tennessee. Phytoplankton excretion and bacterial consumption of organic matter.
- Michael Stewart, Ph.D., Department of Biology, The Open University, Milton Keynes, Buckinghamshire, England. Dissolved nutrients in marine invertebrates.
- Michael Swift, Ph.D., Department of Zoology, Duke University. Photoresponses of *Chaoborus* larvae.
- Laura Tallandini, Ph.D., University of Padua, Padua, Italy. Arthropod hemocyanin; structure-function relationships.
- Jerry Vaughn, Ph.D., Department of Zoology, University of Tennessee. Protein synthesis and turnover in coral and anemones.
- Harold Voris, Ph.D., Department of Biology, Dickinson College. Larval stages of *Octolasmis mulleri*.
- Donald Weston, B.S., Virginia Institute of Marine Sciences. Thermal physiology of hermit crabs.
- Diana Wheeler, M.S., Department of Zoology, Duke University. Crustacean larval behavior.
- Richard White, Ph.D., Department of Botany, Duke University. Plant diversity.
- Lon Wilkins, Ph.D., Department of Biology, University of Missouri. Crustacean chemoreception.

Graduate Students Engaged in Thesis Research (September 1977–August 1978)

- *David Alexander, Department of Zoology
 Sandra Allison, Department of Physiology
 Diane Baxter, Department of Zoology
 *Gene Bennett, Department of Chemistry
 *David Bickar, Department of Biochemistry
 Michael Brenowitz, Department of Biochemistry
 Lawrence Cahoon, Department of Zoology
 *Diane Campbell, Department of Zoology

* Summer only

Thomas Cronin, Department of Zoology
 Donna Dietrich, Department of Zoology
 Martha Farmer, Department of Physiology
 Rolland Fulton, Department of Zoology
 *Pamela Harges, Department of Zoology
 †Rolf Hoffman, State University of New York at Stony Brook
 Paulette Hyland, Department of Botany
 David Manyak, Department of Zoology
 Joseph Martin, Department of Zoology
 Walter Nelson, Department of Zoology
 Sonia Ortega, Department of Zoology
 Patricia Parsley, Department of Botany
 †Raimund Röhl, Department of Chemistry
 †Gene Rosenberg, Department of Biology, Yale University
 Donald Stearns, Department of Zoology
 †Patricia Tester, School of Oceanography, Oregon State University
 Anne Walter, Department of Physiology
 *Garth Ware, Department of Zoology
 Terry L. West, Department of Zoology
 *Diana Wheeler, Department of Zoology

Degrees Awarded (September 1977–August 1978)

Timothy Cowles, Ph.D., Department of Zoology
 John Freeman, Ph.D., Department of Zoology
 Duncan Howe, Ph.D., Department of Zoology
 Lloyd Petrie, Ph.D., Department of Chemistry

Research Technicians

Thea Brouwer, B.S.
 Paul Carlson, M.S.
 Giulia Ferruzzi, M.S.
 Lucretia Garrigan, M.S.
 Gerald Godette, B.S.
 Sally Herring
 Penny Hooper, B.S.
 Patti Krikorian, B.S.
 Jacqueline Paul, B.S.
 Craig Paylor
 Louise Pennell, B.S.
 Jeffrey Schloss
 Patrick Whaling
 Delbert Williams, M.S.

Research Support Staff

David Bunting, Senior Draftsman
 Jeanette Field, Photographic Technician
 William Hunnings, Senior Electronics Technician
 Mary Ann Nelson, Artist/Illustrator

Vessel Operations Staff

Eric B. Nelson, Marine Superintendent of Cooperative Oceanographic Program (R/V *Eastward*)
 George Newton, Assistant Marine Superintendent (R/V *Eastward*); Coordinator (R/V *John de Wolf II*)
 Ragnvald Sandoy, Master of R/V *Eastward*
 Vance Mason, Captain of R/V *John de Wolf II*
 James Willis, Captain of R/V *Beveridge*

R/V Eastward Personnel

Susan Barker, Second Mate
 George Fowler, Relief Mate
 Ralph Jones, Ordinary Seaman
 Edwin Lewis, Oiler
 James Meyer, Oceanographic Party Chief

†Completing research at Duke University Marine Laboratory

Gregory Miller, Oceanographic Party Chief
Curtis Nelson, Chief Engineer
Curtis Oden, Deck Engineer
William Shepherd, Cook/Messman
Benjamin Smith, Steward/Cook
Orville Weeks, First Assistant Engineer
Harold Yeomans, Chief Mate
L. Daniel Yeomans, Wiper

R/V John de Wolf II Personnel

Dale Murphy, Chief Mate
Rick Laubly, Seaman



Seminars



Seminars, Academic Year 1977-1978

Date	Speaker	Topic
27 Sept.	Dr. Steven Wainwright Department of Zoology Duke University Durham, North Carolina	Fiber-wound Sharks
19 Oct.	*Dr. Rudolfo Iturriaga Institut für Meereskunde Universität von Kiel Kiel, West Germany	Bacterial Activity Associated with Sedimenting Particulate Matter
20 Oct.	Dr. Elliott A. Norse Department of Zoology The University of Iowa Iowa City, Iowa	Factors Determining Distribution of American Swimming Crabs
17 Nov.	Dr. Kenneth P. Sebens Museum of Comparative Zoology Harvard University Cambridge, Massachusetts	Optimal Body Size and Population Characteristics of Intertidal Sea Anemones
30 Nov.	Ms. Susan H. Brawley Department of Botany University of California Berkeley, California	Ecological and Embryological Studies of Marine Algae

*Presently conducting research at Duke University Marine Laboratory.



Date	Speaker	Topic
14 Dec.	Dr. Joseph S. Ramus Department of Biology Yale University New Haven, Connecticut	Seaweed Anatomy and Photosynthetic Efficiency: The Ecological Significance of Light Guides, Heterogenous Absorption and Multiple Scatter
11 Jan.	Dr. Charlotte Mangum Department of Biology College of William and Mary Williamsburg, Virginia	The Role of Blood Without an Oxygen Carrier
25 Jan.	Dr. David Hastings Department of Biochemistry Duke University Medical Center Durham, North Carolina	Structural and Functional Properties of the Sodium Pump Isolated from the Blacknosed Shark

Date	Speaker	Topic
25 Jan.	Dr. James Porter Department of Zoology University of Georgia Athens, Georgia	Precise Measures of Community Interactiveness on Coral Reefs and the Effect of a Natural Disaster Thereon Where the Before Is Completely Known
7 Feb.	Dr. Ronald Dimock Department of Biology Wake Forest University Winston-Salem, North Carolina	Chemically Mediated Behavior of Marine Invertebrates
15 Feb.	Dr. David Adams Assistant Secretary N.C. Department of Natural Resources and Community Development Raleigh, North Carolina	North Carolina's Natural Resources
23 Feb.	Dr. Patricia DeCoursey Belle Baruch Institute of Marine Sciences University of South Carolina Columbia, South Carolina	Biological Timing in Crustacea
24 Feb.	Dr. Christopher Martens Department of Chemistry University of North Carolina at Chapel Hill Chapel Hill, North Carolina	A Summer Methane Balance for the Cape Lookout
1 March	Dr. Hermann Rahn Department of Physiology School of Medicine State University of New York at Buffalo Buffalo, New York	Biophysical Aspects of Water Regulation during Incubation
3 March	Ms. Christine Simon Department of Ecology and Evolution State University of New York at Stony Brook Stony Brook, New York	Evaluating Relationships among Cicadids
14 March	Dr. Robert Dolan Department of Environmental Science University of Virginia Charlottesville, Virginia	Problems of Inlet Maintenance

Date	Speaker	Topic
15 March	Dr. Gaylen Neufeld Laboratory of Pharmacology NIEHS Research Triangle Park, North Carolina	Gill Na, K-ATPase and Osmoregulation in the Blue Crab, <i>Callinectes sapidus</i> and the Rock Crab, <i>Cancer irrodatus</i>
28 March	Dr. Roy Carpenter Department of Geology University of Washington Seattle, Washington	High Pressure Liquid Chromatographic Measurement of Pollutants in the Marine Environment
29 March	Dr. Kenneth Storey Department of Zoology Duke University Durham, North Carolina	Metabolic Control in Insects
5 April	Dr. Donald Heinle Chesapeake Biological Laboratory University of Maryland Solomons, Maryland	Feeding of Estuarine Zooplankton
5 April	Dr. Andrew McErlean A-106 Environmental Protection Agency Washington, D.C.	Kepone in the James River Estuary
6 April	Dr. Martin Bilio Director Fish Culture Research Institute Comacchio, Italy	Mariculture in Italy— Tradition, Present Status, and Developmental Trends
10 April	Dr. Burton Edelson Director COMSAT Clarksburg, Maryland	Global Satellite Communications
17 April	Dr. Richard Dugdale Department of Zoology University of Washington Seattle, Washington	The Role of Canopy Formation by Dinoflagellates in Development and Maintenance of Red Tides
18 April	Dr. Thomas O'Conner Ocean Dumping Program Office NOAA-NOS-C3X4 Rockville, Maryland	Ocean Dumping Research with Special Emphasis on Deepwater Dump Site 106 off New York

Date	Speaker	Topic
21 April	Dr. Larry J. Kelts Department of Zoology University of New Hampshire Durham, New Hampshire	The Ecology of Two Tidal Marsh Insects, <i>Trichocorixa verticalis</i> (Hemiptera) and <i>Erythrodiplax berenice</i> (Odonata) in New Hampshire
25 April	Dr. Lauriston King Office of the IDOE National Science Foundation Washington, D.C.	Marine Policy within the National Science Foundation
1 May	Dr. Michael G. Hadfield Department of Zoology University of Washington Seattle, Washington	Stimulus and Response in Settlement and Metamorphosis of Molluscan Larvae
10 May	Dr. Quentin Gibson Department of Biochemistry Cornell University Ithaca, New York	Reaction of Oxygen with the T-State of Mammalian Hemoglobin
11 May	Dr. Gilbert Rowe Woods Hole Oceanographic Institution Woods Hole, Massachusetts	Sources of Organic Matter in the Deep Sea
12 May	Dr. Charles Epifanio College of Marine Studies University of Delaware Lewes, Delaware	Aspects of Oyster Culture



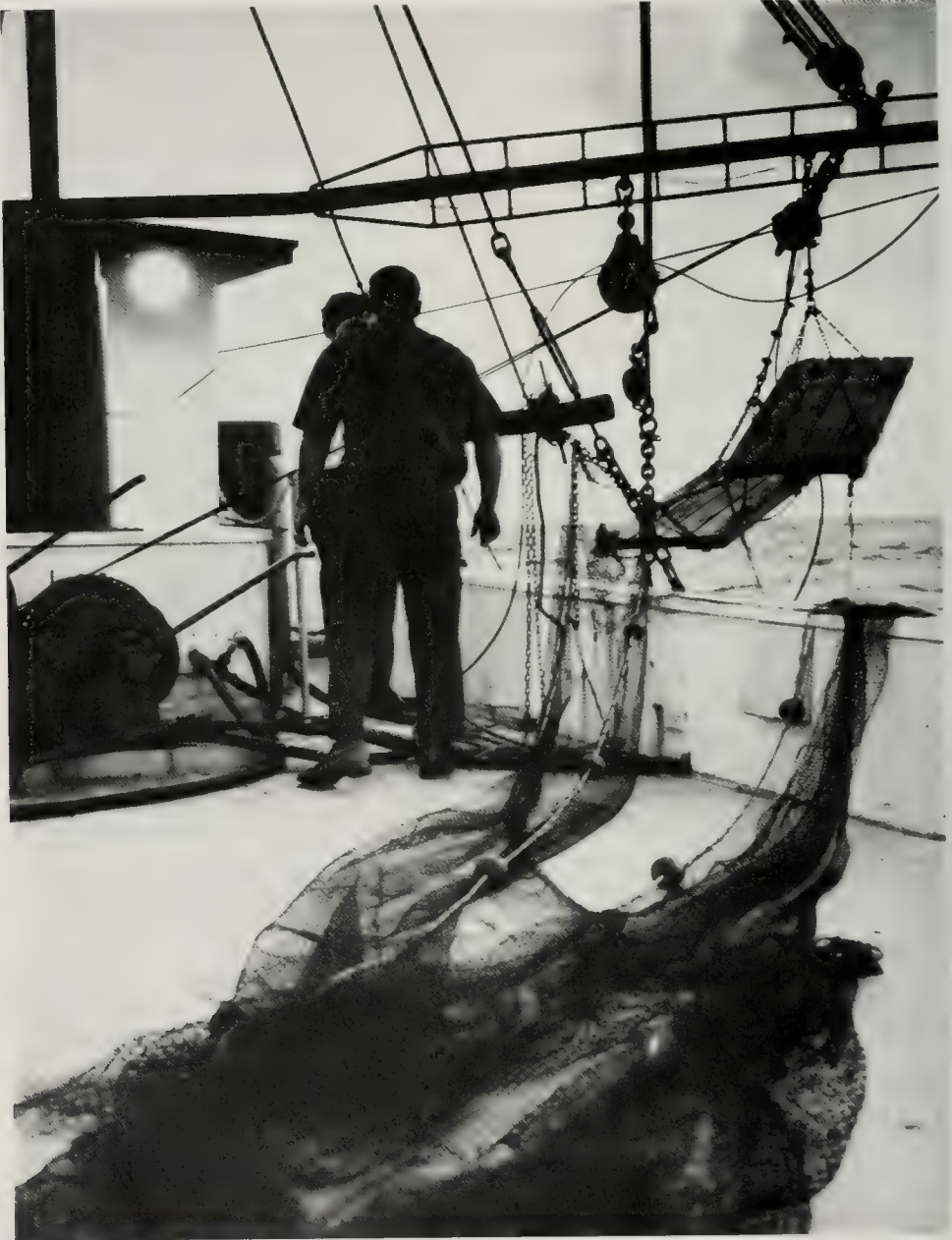
Date	Speaker	Topic
18 May	Dr. Larry Atkinson Skidaway Institute of Oceanography University System of Georgia Savannah, Georgia	Results of Onslow Bay 1975 and 1976 Observations: The Effect of Gulf Stream Intrusion
25 May	Dr. Daniel Livingstone Department of Zoology Duke University Durham, North Carolina	Productivity and Evolution in Tropical African Lakes
29, 30 May	Dr. Ruth Turner Museum of Comparative Zoology Harvard University Cambridge, Massachusetts	Larval Development in Boring Bivalves; Ecology of Deep Sea Boring Bivalves
31 May	Dr. Norman Christensen Department of Botany Duke University Durham, North Carolina	The Role of Fire in the Ecology and Evolution of Coastal Plain Pine Savannas
9 June	Dr. John S. Pearse Museum of Comparative Zoology Harvard University Cambridge, Massachusetts	Ecological Studies in a California Kelp Forest: A Sea Otter Habitat
14 June	Dr. John Siddall Zoecon Corporation Palo Alto, California	Studies on Insect and Crustacean Hormones
15 June	Ms. Patricia Parsley Department of Botany Duke University Durham, North Carolina	Dynamics of Phytoplankton Species in the South River Estuary
21 June	Dr. John Sutherland Duke University Marine Laboratory Beaufort, North Carolina	Comparative Studies on the Dynamics of Fouling Communities
28 June	Dr. Jeffrey S. Levinton Department of Ecology and Evolution Division of Biological Sciences State University of New York at Stony Brook Stony Brook, New York	Adaptation in the Mussel, <i>Mytilus edulis</i> , along a Cline at an Enzyme Locus
5 July	Dr. John B. Morrill Division of Natural Sciences University of South Florida Sarasota, Florida	Development of Pulmonate Snails
12 July	Dr. James N. Siedow Department of Botany Duke University Durham, North Carolina	The Role of Ubiquinone in Plant Mitochondrial Electron Transfer

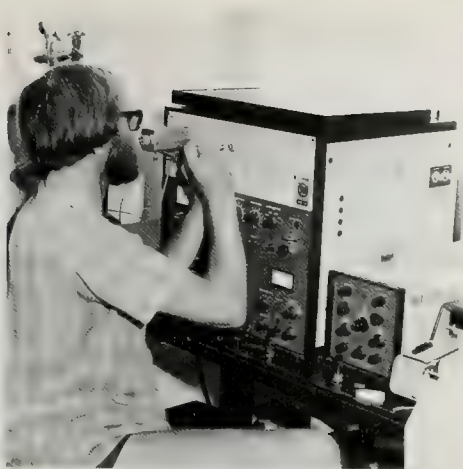
Graduate Student Seminars, Academic Year 1977-1978

Date	Speaker	Topic
14 Sept.	Mr. Timothy Cowles Department of Zoology Duke University Durham, North Carolina	Copepod Feeding Behavior in the Peru Upwelling
21 Sept.	Ms. Martha Farmer Department of Physiology Duke University Durham, North Carolina	A Rare Hemoglobin from a Rare Mammal
5 Oct.	Mr. Donald Stearns Department of Zoology Duke University Durham, North Carolina	Phototaxis in the Calanoid Copepod <i>Acartia tonsa</i> Dana
12 Oct.	Mr. Walter Nelson Department of Zoology Duke University Durham, North Carolina	Seagrass Amphipod Communities from Nova Scotia to Florida
27 Oct.	Ms. Anne Walter Department of Physiology Duke University Durham, North Carolina	Some Aspects of Osmoregulation in Sea Gulls
9 Nov.	Ms. Sandra Allison Department of Physiology Duke University Durham, North Carolina	Turgor Regulation in <i>Valonia macrophysa</i> after Acute Hypoosmotic Shock
30 Nov.	Mr. John Freeman Department of Zoology Duke University Durham, North Carolina	The Effects of Ecdysone and Molt-Inhibiting Hormone on the Crustacean Epidermis
14 Dec.	Mr. Thomas Cronin Department of Zoology Duke University Durham, North Carolina	Field Distribution of Crab Larvae
11 Jan.	Ms. Paulette Hyland Department of Botany Duke University Durham, North Carolina	Exploration at Ten Fathoms: Preliminary Results on the Seasonal and Spatial Composition and Development in a Marine Benthic System

Date	Speaker	Topic
25 Jan.	*Ms. Pat Tester School of Oceanography Oregon State University Corvallis, Oregon	Effect of Temperature on Growth and Molting in the Marine Copepod Genus <i>Acartia</i> - Proposed Research

*Presently conducting research at Duke University Marine Laboratory.





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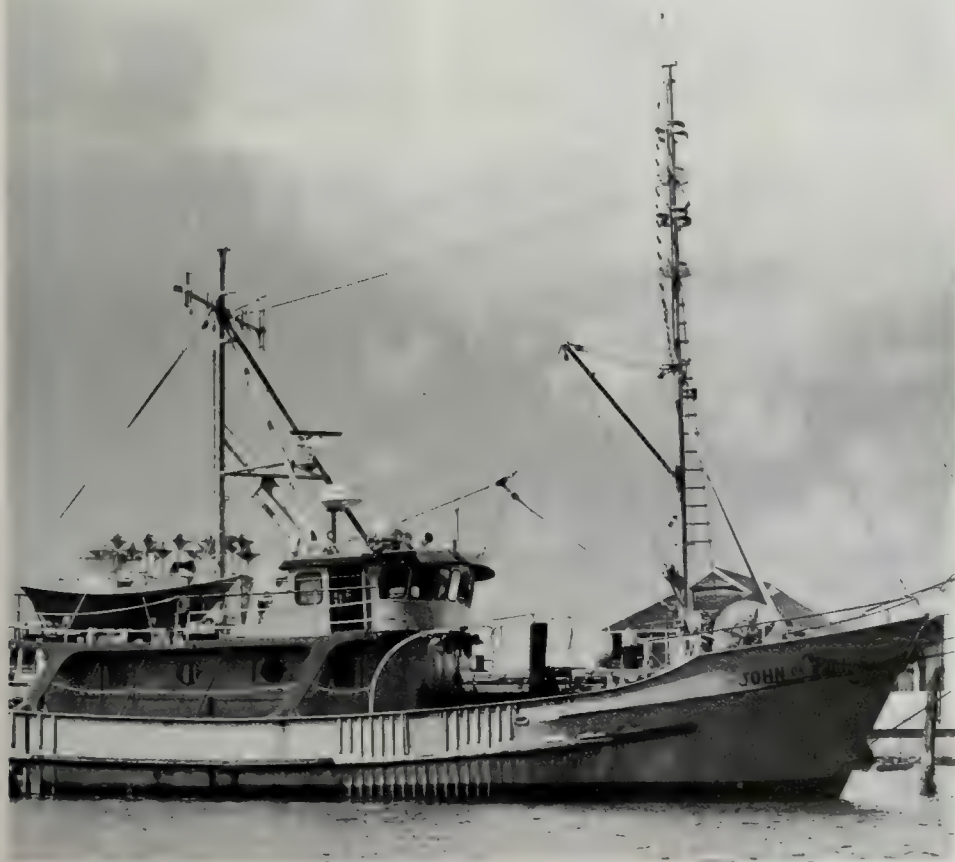
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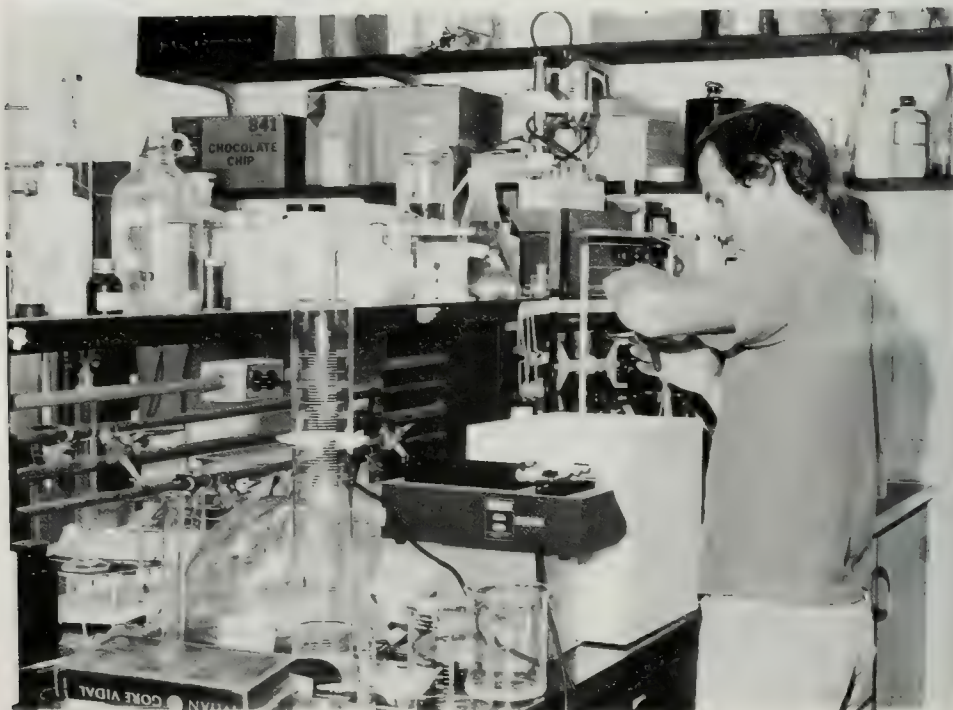
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APPLICATION FOR ENROLLMENT IN THE DUKE UNIVERSITY MARINE LABORATORY
SUMMER SESSION

Please type or use black ink.

Date

Name.....
Last First Middle

Date of Birth: Month Day Year

Social Security No.....

Reserve a place for me in the following course(s): (Only one 6-unit course per term will be permitted, first and second choice should be indicated) *Each applicant is required to submit a transcript of grades to the admissions office.*

FIRST TERM:

Course Number	Title of Course
.....
.....

SECOND TERM:

Course Number	Title of Course
.....
.....

THIRD TERM:

Course Number	Title of Course
.....
.....

Reserve a room: Term I..... Term II..... Term III.....

Attended Summer Sessions at Duke University Marine Laboratory: Yes ☐ No ☐

Years

Request grade(s) be applied toward: If college student, list:

Undergraduate credits..... Undergraduate Year

Graduate credits..... Graduate.....Year

General (unclassified)

Name and address of school:

Are you currently employed as a full-time elementary school, secondary school, or college teacher?

If so, list name and address of school:

Male

Female

Colleges and/or universities attended and degrees:
.....
.....

List major (or degree received in):

List courses currently in progress (which would not yet appear on a transcript): ..
.....
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Current address:

Street.....

Rural Route or P. O. Box

City.....State.....Zip

Area CodeTelephone Number

Forwarding address:

Street.....

Rural Route or P. O. Box

City.....State.....Zip

Area CodeTelephone Number

Mail to:

Admissions
Duke University Marine Laboratory
Beaufort, North Carolina 28516

APPLICATION FOR ENROLLMENT IN THE DUKE UNIVERSITY MARINE LABORATORY
SPRING SEMESTER MARINE SCIENCES PROGRAM FOR UNDERGRADUATES

Please type or print

Date

1. Name
Last First Middle

2. Social Security Number Male ☐ Female ☐

3. Date of Birth: Month Day Year

4. A. Current mailing address:

Street or P.O. Box

City State Zip

Area Code Telephone Number

B. Permanent or home address:

Street or P.O. Box

City State Zip

Area Code Telephone Number

5. Name and address of next of kin:

Name Relationship

Street or P.O. Box

City State Zip

Area Code Telephone Number

6. A. Duke University undergraduate student:

Trinity College of Arts and Sciences

Engineering

B. Special student desiring transfer credit:

Name and address of home institution

.....

City State Zip

C. Major department Class

D. List courses currently in progress (which would not yet appear on a transcript):

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7. The following persons have been requested to mail letters of recommendation to the admissions office of the laboratory:

A. NamePosition.....

City.....State.....Zip.....

Area Code.....Telephone Number.....

B. NamePosition.....

City.....State.....Zip.....

Area Code.....Telephone Number.....

8. Transcript(s) will be sent by the following institution(s):

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9. Have you ever been placed on probation or suspended or dismissed from any school?

Yes ☐ No ☐ (If yes, please explain below.)

Mail application to:

Admissions
Duke University Marine Laboratory
Beaufort, North Carolina 28516



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Graduate School

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Typesetting by Electronic Composition, Inc., Washington, D.C.
Printed by William Byrd Press, Richmond, Virginia

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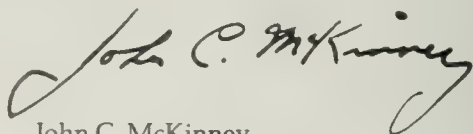
To the Prospective Graduate Student at Duke University

Several years ago a committee of distinguished scholars was appointed and asked to appraise the state of graduate education at Duke University and indicate guidelines for its future development. I would like to quote briefly from the preamble of their report:

The primary role of a university is to provide a focus for the growth of ideas. Since ideas grow in the minds of men, communication between scholars, between faculty and students—in short, teaching—is the first basic function of a university. But without great ideas to communicate—ideas old and new, traditional and nascent—teaching is an exercise of futility. Therefore, the second basic function of a university must be research, characterized by the spirit of free inquiry and the exploration, analysis, and synthesis of ideas. These two faces of a university are complementary.

Even in the undergraduate college or in the professional school, the student learns best when moved by a spirit indistinguishable from the mood of the scholar engaged in original research. The ideas taught are, in fact, new to the student and therefore fit material for his “original” research. But it is in the graduate school that teaching and research become truly inseparable.

To the student in search of a superior graduate education, Duke University has much to offer: excellent research facilities such as an outstanding library, a major computing center, modern laboratories—but above all, a highly productive graduate faculty dedicated to the twin functions of teaching and research. The following pages, and the information they contain, are addressed to the student seeking a soundly based graduate education.

A handwritten signature in dark ink, reading "John C. McKinney". The signature is fluid and cursive, with a large, sweeping initial "J" and a stylized "M".

John C. McKinney
Dean of the Graduate School





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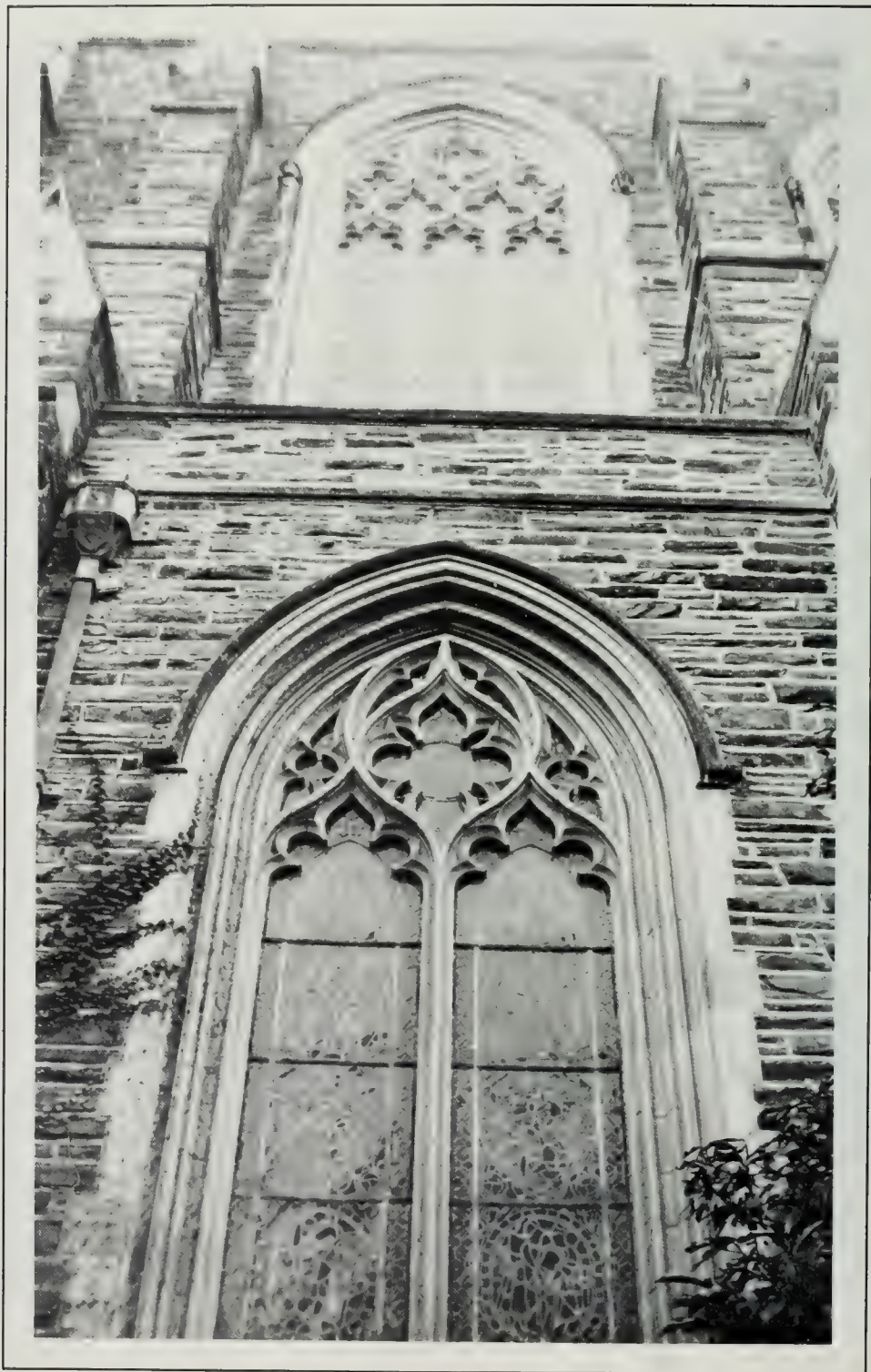
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Introduction



A Community of Scholars

Writing in the 1920s the philosopher and man of science Alfred North Whitehead defined the purpose of a university in these terms: "The justification of a university is that it preserves the connection between knowledge and the zest for life, by uniting the young and the old in the imaginative consideration of learning." If this is true of a university generally, it is true of a graduate school especially. Faculty members and graduate students work together in the imaginative recasting of ideas necessary for successful research and the development of human knowledge.

Ideally, a graduate school is a community of scholars engaged in imparting and extending the realm of human knowledge in the arts and sciences. A select group of students is admitted each year to undergo the rigorous discipline of an advanced degree program, the successful among them to emerge as scholars of promise. To enter upon graduate education today is to accept a real challenge, but this decision should not be made casually. The work toward a doctorate requires several years of tireless effort and possible sacrifice, and the material rewards may be less certain than in some alternative endeavor. However, pursued with determination, graduate education can be the doorway to a stimulating, creative, and meaningful life. The student who is contemplating this challenge may have many questions in mind; the material that follows is an attempt to answer some of them.

The Decision to Go to Graduate School

The decision to work toward an advanced degree must be a personal commitment born of a willingness to devote oneself to many months or possibly years of academic discipline just at an age when one may be impatient for financial independence and freedom from academic discipline. Graduate education requires all the energy, enthusiasm, and self-discipline at one's disposal; to enter upon it half-heartedly is to invite discouragement or failure.

An equally important requisite for success in graduate study is the possession of a natural curiosity and the capacity for self-discipline. A good undergraduate record may or may not be adequate evidence of these characteristics. Many students with excellent undergraduate records have been unsuccessful in graduate study because their undergraduate training stressed an ability to marshal facts and to articulate these facts rather than real understanding and analysis of material. On the other hand, many distinguished scholars had undistinguished undergraduate

records. In gaining admission to a graduate school, the undergraduate record is, of course, an important element, but usually some margin is left to allow for students who develop serious academic interests late in their undergraduate careers. Students are often best able to judge for themselves whether or not their grades are a true gauge of their ability.

There is no unerring way of knowing in advance whether one will be successful or happy in graduate school. It is quite likely, however, that if one has both the motivation and ability and does not try it, there will be regrets in later years. Although the decision must be an individual choice, superior intellectual ability is a scarce human resource, and the encouragement and utilization of it is a matter of community as well as personal concern.

Choosing a Graduate School

Over two hundred and fifty universities today offer work leading to the Ph.D. degree. Among these are about sixty institutions which grant only two or three such degrees a year in all fields combined. At the other end of the scale are about fifty universities which account for nearly 70 percent of all doctorates granted in this country. Duke University is among the latter, as are most of the major institutions which offer programs ranging the breadth of academic disciplines. But even if one can narrow the field to about fifty major institutions, how does one select among these, and what factors should affect one's final choice? A few key factors are discussed briefly below.

Size. Size is not an infallible guide to the quality of a graduate school. There are a number of poor graduate schools of exceedingly large size and a number of extremely good small ones. However, it might be helpful simply to mention a few of the disadvantages of too many or too few students.

An extremely large graduate school—there are some which have between six and twelve thousand enrolled—is not the ideal of a small number of superior students working closely in intellectual pursuits with a few esteemed scholars. Classes of fifty to a hundred students, inaccessibility of senior faculty, shortage of library materials and facilities, and only a nodding acquaintance with fellow students are a few of the possible drawbacks. An able student may develop well even in this atmosphere of mass production, but it is hardly the ideal.

An extremely small graduate school also has its disadvantages. Facilities are often limited, and the faculty is likely to be primarily composed of undergraduate instructors. A university must be willing to commit a significant portion of its resources to develop a graduate program of high quality and this is often not the case in an extremely small graduate school.

More important than the size of the entire graduate school is the size of the particular departmental program in which a student is interested. An optimum doctoral program will have an enrollment of perhaps thirty to one hundred students, admitting fifteen to forty new students each year, and turning out perhaps three to ten Ph.D.s per year. This information is usually available in university catalogues or government publications on higher education.

Duke University is committed to programs of moderate size in which the interests of the student are important. Total enrollment in the Graduate School is about sixteen hundred students. Between four and five hundred new students are admitted each year from approximately four thousand applications. Only four departments have more than eighty students; seventeen departments have enrollments that fall within the optimum range suggested in the preceding paragraph.

Quality. Universities differ considerably in their reputation for quality, and there are marked differences among departments within any university. Many



excellent universities have a few weak departments in which a student would fare less well than in an excellent department in a less esteemed institution. Therefore, the student should not be guided solely by the reputation of a university as a whole, but should inquire more specifically about the area of specialization.

Since judging the quality of a graduate program is necessarily subjective, no two people are likely to be in complete agreement. Prospective students would do well to talk with their undergraduate professors, particularly those who have themselves achieved some reputation in the world of scholarship. As witnessed by their own continuing writing and research, they are more likely to have reliable information on the merits of various graduate programs. Similarly, younger faculty members who are only four or five years out of graduate school may have more recent acquaintance with their own and other schools.

Another guide may be occasional questionnaires asking other educators to rank various graduate departments.

Alone, none of these guides is adequate; however, in conjunction with individual advice and recommendations, they can serve as useful indicators. In summary, the best procedure is to take as many factors as possible into account, and then to apply to three or four of the schools high in consideration. (Applying to fifteen universities is a waste of an applicant's and the universities' time.) Write to the graduate school or to the departmental director of graduate studies if further information is desired; visit the university in person, if possible; and carefully weigh the advice of distinguished faculty members of one's undergraduate college.

Duration of Program

The length of time a graduate student spends in study toward an advanced degree depends upon the requirements of the individual program, on personal work habits, and on the environment of the graduate school and the department in which the study is conducted.

The student's level of preparation before entering graduate school has a direct bearing on the speed with which the degree may be earned. A student who enters with proficiency in one or more foreign languages, and a good foundation in the

chosen field may well be able to finish within the minimum time limits. On the other hand, the student who is not as well prepared may find that one and a half to two years are the minimum for the A.M. degree, and four to five years for the Ph.D. degree (although wise use of the summers may reduce this time somewhat). The total time may also be lengthened if the student must work during part of the period of residence.

The attitude of the graduate school and its various departments will also affect the time needed to complete the degree. During the last decade the average time elapsing between entering graduate school and receiving the doctorate in American universities has been about ten years. A study of experience at Duke during the early 1950s indicated that the average doctorate in the humanities required a little over seven years, nearly six years in the social sciences, and slightly over four years in the sciences. Over the last few years, however, Duke University has been among the forerunners in reducing the time needed to obtain the Ph.D. without any sacrifice in quality. The effort has taken the form of trying to eliminate the unnecessary delays, particularly those due to financial burdens on the student. Duke ranks among the leading institutions in the country today in terms of financial aid per student from university sources. Moreover, much of this aid is in the form of fellowships and scholarships which do not require burdensome services in return. The large public institutions are often more restricted to awards which require substantial teaching, research, or other duties, thus reducing the speed with which a student can complete the resident course work. A student will be wise to inquire to what extent progress toward a degree may be delayed by the work entailed in certain awards. If, for example, an assistantship lengthens unduly the time necessary to obtain a degree, a smaller fellowship may be preferable.

Another way in which Duke encourages deliberate speed toward fulfilling degree requirements is through its tuition charges. Many graduate schools charge tuition for three full years in a doctoral program. In 1958 Duke adopted the policy of charging full tuition and fees only up to the time the doctoral student passes the preliminary examination. (This examination is taken upon completion of all course and language requirements, usually at the end of the second year, before the



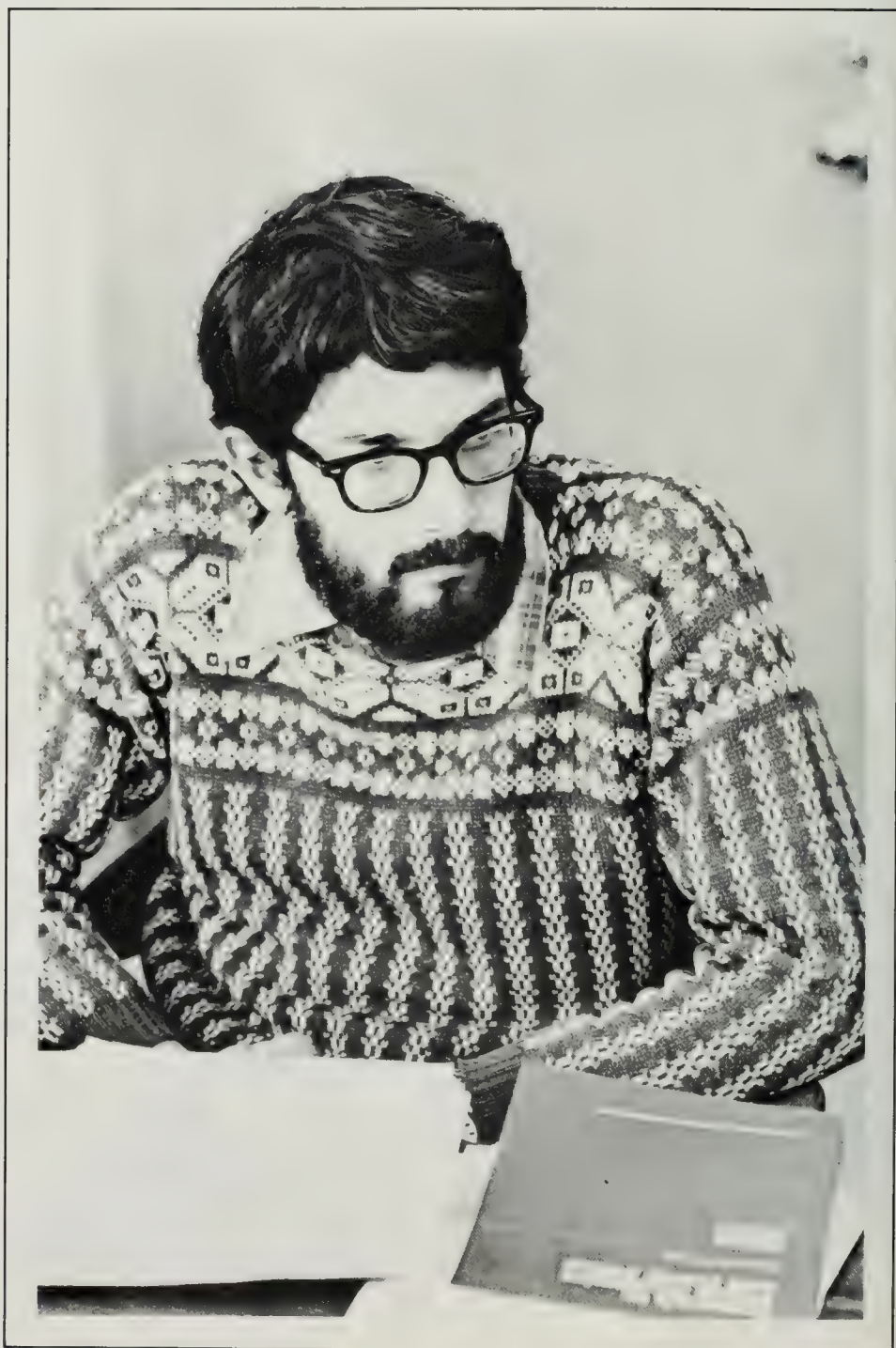
student is formally admitted to candidacy for the Ph.D.) After "prelims," tuition charges are substantially reduced. In choosing a graduate school, a prospective student should inquire about the fees for a full doctoral program, not merely the charges for the first year. The tuition and fee system at Duke has worked to encourage both students and their departments to arrange for preliminary examinations to be taken before the beginning of the third year. Some years ago fewer than half of the doctoral students at Duke took this examination before the beginning of the third year; today over 90 percent are doing so. This plan, aided by scholarship and fellowship aid, gives graduate students at Duke a marked advantage over their counterparts in many other graduate schools in acquiring their degrees in the minimum amount of time.

The duration of the graduate program, therefore, depends on many factors, but the policy of the Duke Graduate School is to keep the length of time a student is involved in obtaining an advanced degree at a minimum.

Policy of Nondiscrimination

Duke University does not discriminate on the basis of race, color, national and ethnic origin, sex, or handicap in the administration of educational policies, admission policies, financial aid, employment, or any other University program or activity. It admits qualified students of any race, color, national and ethnic origin to all the rights, privileges, programs, and activities generally accorded or made available to students.

Duke University Graduate School



Teaching and Research

In surveying the progress made in the first seven years after the founding of Duke University, its first President, William Preston Few, wrote that he wanted "to see the Graduate School made strong because it will best and most quickly insure our attaining and maintaining a place of real leadership in the educational world." President Few believed that "more than anything else here our Graduate School will determine the sort of University we are to build and its standing in the educational world." These opinions have continued to prevail to the present day, with emphasis upon the interdependence of teaching and research as the necessary components of scholarship.

Over six hundred members of the graduate faculty teach the approximately six hundred courses and seminars offered in the Graduate School, and supervise thesis and dissertation research. Many of the major universities of the world have helped to train this faculty; approximately 90 percent of the graduate staff hold degrees from the fifty institutions which make up the Association of Graduate Schools within the Association of American Universities. By place of birth they represent almost every state in the nation and almost two dozen foreign countries.

The sixteen hundred graduate students currently enrolled represent a similar diversity of background. Approximately 34 percent of the students are from undergraduate institutions in the South Atlantic states, 22 percent from the middle Atlantic states, 12 percent from New England, 18 percent from the central states, 1 percent from the mountain states, 7 percent from the Pacific states, and 6 percent from foreign countries.

The groundwork for learning may be laid in privacy—indeed a certain amount of private study and research is absolutely essential—but the vital stimulus to the learning process comes from one's contact with the minds of other people with similar or related interests. This is precisely why graduate schools are highly selective in their admissions policy, and it is one of the important reasons for their willingness to offer attractive fellowship awards to outstanding students. The superior student is a valuable catalyst both for fellow students and for faculty and is prized as such.

Faculty and students comprise the essential human factors in education, but their joint endeavor cannot prosper without adequate research and library facilities. Duke University has research facilities for physics, botany, zoology, chemistry, psychology, sociology, engineering, and biochemistry. These laboratories have been built entirely within recent years, and modernization and expansion have occurred in other scientific areas. The University has an excellent Computa-

tion Center on the campus and shares a computing facility with the University of North Carolina and North Carolina State University. The Triangle Universities Computation Center is among the largest research-oriented computer facilities in the world. The University has a fine research library; the twentieth largest university library in the nation, second in the south, and first in the southeast. In number of volumes, breadth of coverage, serials, and documents, it is a much more adequate library than that available in many graduate schools with an enrollment two or three times as large. To the student in the arts, humanities, and social sciences, for whom the library is the bloodstream of scholarship, this is an immeasurable asset.

Among the many special features of the Graduate School a few important examples may be mentioned. For students in the biological and physical sciences, the facilities of the Duke Marine Laboratory at Beaufort, North Carolina, are available for course work and research. The Laboratory has research buildings, classrooms, motor vessels (including the 118-foot oceanographic ship, the R/V *Eastward*, and a new research vessel, the 62-foot R/V *John de Wolfe II*), and living quarters, which make it an excellent research center in marine biology. Closer to home are the 8,000 acres of Duke Forest, managed by the School of Forestry, ideal for research on timber growth, soils, and related topics. A regional nuclear structure laboratory is housed on the campus and serves the major universities in the area. The phytotron, adjacent to the botany greenhouses, is an integrated series of plant-growth rooms, chambers, and greenhouses, with forty-six separately controlled environments providing more than 4,000 square feet of plant-growing space. The factors of the environment controlled in the units to study plant growth include light, temperature, nutrients, CO² concentration, and humidity.

Additional resources and facilities are available to the graduate student because of Duke's fine Schools of Law, Business Administration, Nursing, Medicine, Engineering, Forestry and Environmental Studies, and Divinity. A three-term summer session and the availability of courses at the nearby University of North Carolina at Chapel Hill, North Carolina Central University in Durham, and North Carolina State University at Raleigh under a cooperative arrangement offer other opportunities to the graduate student.

No description of programs can begin to give the prospective student the full flavor of graduate study in a particular institution. A visit to the universities in which one is particularly interested may be helpful in giving one a better picture. If this should be practical, the Duke Graduate School offers a warm invitation to prospective students to come to the campus during the year to discuss their possible application and admission. The visitor will find at Duke most of the facilities that one could hope for in the largest of institutions, and yet the University has been fortunate in avoiding many of the evils inevitable with mass education. Despite the total University enrollment of approximately 9,000, Duke has retained the sense of community that one usually associates with a smaller liberal arts college. And in an age when current architectural whim often adds yet one more variant style to an already assorted array of buildings, Duke has built a campus of unusual and architecturally coherent beauty. This, too, is an important part of education, creating an environment conducive to learning.

Special Programs

Special and cooperative programs at Duke include: Center for the Study of Aging and Human Development; Canadian Studies Program; Center for Commonwealth and Comparative Studies; Program in Comparative Studies on Southern Asia; Cooperative Program in Teacher Education (Secondary M.A.T. Degree); Cooperative Program (with the University of North Carolina at Chapel Hill) in



Russian and East European History; Center for Demographic Studies; Duke Environmental Center; University Program in Genetics; Hispanic Studies Program; Center for Islamic and Arabian Studies; Medical Scientist Training Program; Medical Historian Training Program; Program in Medieval and Renaissance Studies; Oak Ridge Associated Universities; Organization for Tropical Studies; Institute for Policy Sciences and Public Affairs; Round Table on Science and Public Affairs.

Further information may be obtained by writing the individual program c/o Duke University, Durham, North Carolina 27706 or by writing the Graduate School Office.

General Regulations Governing Graduate Studies

The official detailed *Bulletin of the Graduate School*, published in March of each year, gives an account of regulations concerning graduate work at Duke University and a full description of course content. The following pages are a summary of these materials for 1979-80 and should provide sufficient information for the prospective student. The bulletin is normally mailed to each student who is admitted to the Graduate School in the late spring of the year of matriculation so that the course program may be planned for the first year.

Admission

Admission is required of (1) all students who intend to pursue study toward a degree offered by the Graduate School, (2) all other students who desire credit for whatever purpose for graduate courses—except students who register as special students in the Summer Session. Students who have discontinued a program of study after earning a master's degree here must by letter request permission of the Dean to undertake a doctoral program.

A student seeking admission to the Graduate School of Duke University must have received an A.B. or B.S. degree (or the equivalent in the case of foreign students) from an accredited institution. The student's undergraduate program should be well rounded and of such quality as to give positive evidence of capacity for graduate study. Ordinarily the student should have majored in the area of intended graduate study. Many departments (see the section on Advanced Degree Programs at Duke) list specific prerequisites. Students are urged to anticipate the language requirement and are reminded that Educational Testing Service Graduate School Foreign Language Tests in French, German, Russian, and Spanish are offered to undergraduate and graduate students at many centers on nationally uniform dates (see the section on Language Requirement).

Procedures. A student seeking admission to the Graduate School should request the Dean of the Graduate School to send an application form. This should be filled out completely and returned promptly. Each application must be accompanied by a nonrefundable fee of twenty-five dollars in check or money order payable to Duke University. In addition, the student is required to provide the following supporting documents: (1) two copies of the official transcript from each college, university, or seminary attended sent to the Dean directly by the institution; (2) as soon as possible, two supplementary transcripts showing completion of work which was in progress when the earlier transcript was made; (3) three letters of recommendation, written on the forms provided, by persons best qualified to judge the applicant as a prospective graduate student, and mailed directly to the Dean; (4) scores on the Graduate Record Examination Aptitude Test for all departments; and (5) scores on the Graduate Record Examination Advanced Test for the Departments of Biochemistry, Botany, Chemistry, English, Mathematics, Microbiology, Pathology, Pharmacology, Physics, Physiology, Romance Languages, and Zoology.

Applicants to the Department of Health Administration are also required to take the Graduate Management Admission Test, administered by the Educational Testing Service.

Students applying for financial aid in all departments should take the Graduate Record Examination no later than the October testing in order to meet the February 1 deadline. Information on times and places of the Graduate Record Examinations can be provided at the applicant's college or by the Educational Testing Service, Princeton, New Jersey 08540, or Berkeley, California 94704.

Fully qualified students from outside the United States are welcome to apply for admission to a degree program. The foreign student must, in addition to the information required of all students, submit the following materials: (a) if the student's native language is not English, certification of English proficiency demonstrated by scores from the Test of English as a Foreign Language (TOEFL), administered through the Educational Testing Service in Princeton, New Jersey, and (b) a statement showing financial arrangements for the proposed term at Duke (estimated costs per calendar year are \$10,000).

All foreign students whose native language is not English will be examined during their first registration period for competence in the use of oral and written English. Until competence is determined, admission and arrangements for an

award involving teaching must remain provisional. Students found to lack the necessary competence will be required to enroll in the noncredit course called English as a Second Language and to reduce their course or research program by 3 units.

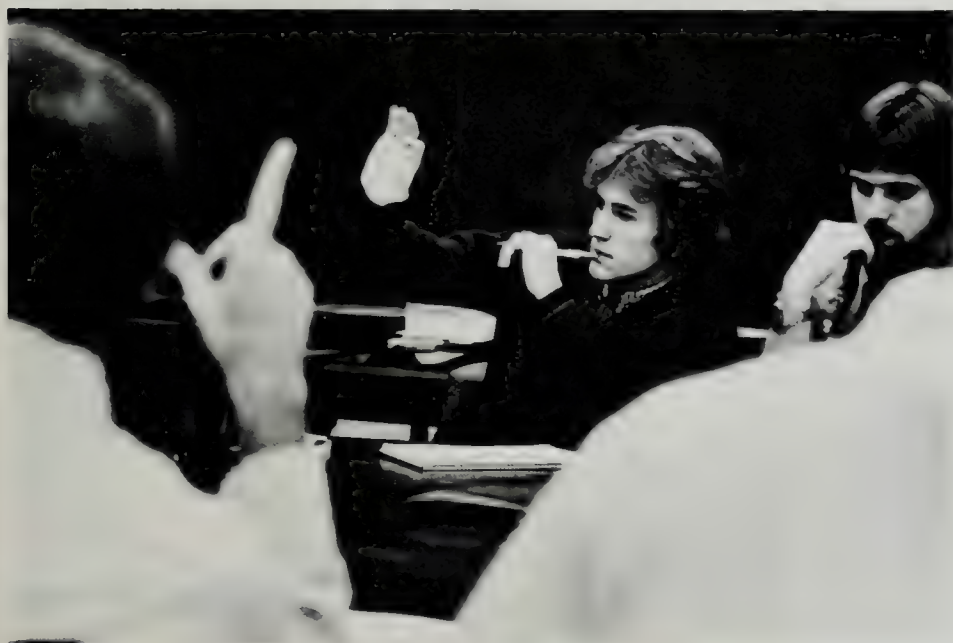
A student who does not successfully pass this course during the first year of residency will not be permitted to continue graduate work at Duke University. Passing this examination will not meet degree requirements for a foreign language.

When admission is approved, the student will receive a letter of admission and an acceptance form. The process of admission is not complete until the student returns the acceptance form.

Applicants who are admitted will be offered full admission, provisional admission, or nondegree admission. *Provisional admission* for a trial period of one semester or a minimum of 12 hours of course work is offered to students who appear to warrant admission but do not fully comply with admission requirements. Graduate credit earned under provisional status may be applied toward an advanced degree at Duke University if and when the student is granted full admission. *Nondegree admission* is offered to students who meet the admission requirements and who desire to engage in graduate study not subject to the restrictions of a graduate degree program. With the approval of the student's major department and the Dean of the Graduate School, a maximum credit of 6 units earned under nondegree status may be applied toward an advanced degree at Duke University if and when the student is granted full admission.

It is the applicant's responsibility to make certain that the Office of the Graduate School has received all required material before the specified deadlines. Because applications cannot be reviewed until all supporting documents are filed, applications should be submitted two weeks before the closing dates listed below. Materials submitted in support of an application are not released for other purposes and cannot be returned to the applicant.

We encourage all candidates to complete their application by February 1. Anyone whose folder is not complete by that date will face the possibility that departmental enrollment will have been filled.



Earning the Degrees

Duke University offers graduate programs leading to the specified advanced degrees in the following fields:

Anatomy, A.M., Ph.D.	Health Administration, M.H.A.
Anthropology, Ph.D.	History, A.M., M.A.T., Ph.D.
Art History, A.M.	Mathematics, A.M., M.A.T., M.S., Ph.D.
Biochemistry, Ph.D.	Mechanical Engineering and Materials Science, M.S., Ph.D.
Biomedical Engineering, M.S., Ph.D.	Microbiology and Immunology, Ph.D.
Botany, A.M., M.S., M.A.T., Ph.D.	Pathology, M.S., Ph.D.
Business Administration, Ph.D.	Pharmacology, Ph.D.
Chemistry, A.M., M.A.T., Ph.D.	Philosophy, A.M., Ph.D.
Civil Engineering, M.S., Ph.D.	Physical Therapy, M.S.
Classical Studies, Ph.D.	Physics, A.M., Ph.D.
Computer Science, A.M., Ph.D.	Physiology, Ph.D.
Economics, A.M., Ph.D.	Political Science, A.M., Ph.D.
Education, M.Ed., M.A.T., A.M., Ed.D., Ph.D.	Psychology, Ph.D.
Electrical Engineering, M.S., Ph.D.	Public Policy Sciences, A.M.
English, A.M., M.A.T., Ph.D.	Religion, A.M., Ph.D.
Forestry, A.M., M.S., Ph.D.	Romance Languages, A.M., Ph.D.
Geology, M.S., Ph.D.	Sociology, Ph.D.
Germanic Languages and Literature, A.M.	Zoology, A.M., M.A.T., Ph.D.

The Language Requirement

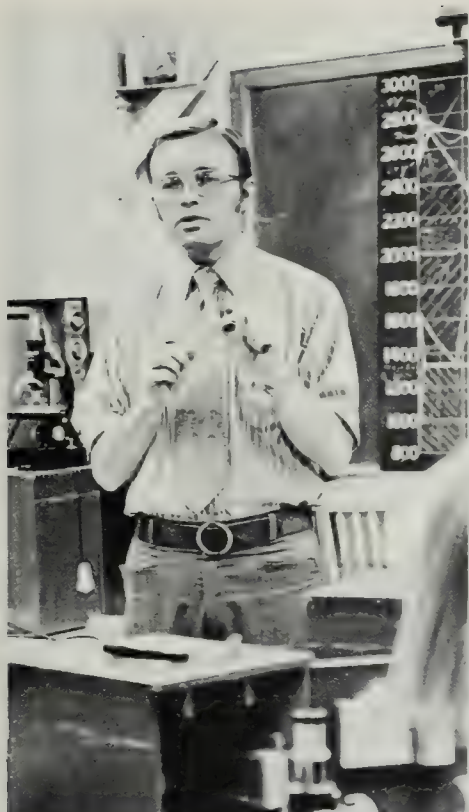
Although individual departments establish their own minimal requirements (see individual departmental headnotes in this bulletin), the regulations of the Graduate School require no foreign language for the master's degree, and, in many departments, a reading knowledge of one foreign language, ancient or modern, for the Ph.D. degree. The languages normally required are French, German, and Russian, but others may be offered if appropriate and approved. The foreign language requirement may be satisfied in the following ways: (1) by a passing score on one of the ETS examinations administered at any national center (including Duke) and taken no longer than six years before the preliminary examination, (2) by transfer from another institution, with the limitations set forth in the more detailed *Bulletin of the Graduate School*, (3) in any language for which ETS tests are not available, by a reading examination administered by a qualified examiner and arranged by the graduate school office, or (4) by a reading examination in any foreign language, administered by a qualified member of the faculty under a procedure specified by the department and approved by the Dean and the Executive Committee of the Graduate Faculty.

Advanced level, noncredit reading courses in French and German are provided for students who need them.

In special circumstances a department that wishes to do so may ask the Dean and the Executive Committee of the Graduate Faculty to waive the language requirement.

Other Requirements

The general requirement for a master's degree is a minimum of 30 units (semester hours) of course-seminar-research credit. The student must present





acceptable grades for a minimum of 24 units of graduate courses. The nature of the additional 6 units for which students must register depends on whether they are enrolled in thesis or nonthesis programs; i.e., these last 6 units are earned either with successful submission of the thesis or with such other courses or academic exercises as are approved by the students' departments. In the M.A.T. program, practice teaching is included for students who lack it, and for those students a minimum of 36 units is the number required. A pattern of major and related work is prescribed for the course-seminar work, allotting half or more of the units to the major. For example, the M.Ed. program allows at least half of the units to fall within the student's teaching field, and the M.A.T. allows a major in either education or in teaching fields, according to the student's previous training.

A master's program can be completed in one academic year, but the student who presents a thesis usually needs at least a calendar year, and foreign students should be prepared to study for two years. The maximum length of time permitted from first registration to completion of all requirements is six years. Under certain circumstances a maximum credit of 6 units may be transferred toward the master's degree for graduate courses completed elsewhere, provided the grades earned in the particular courses were not less than *B* or equivalent. In such a case, however, the transfer of graduate credit does not reduce the required minimum registration for a master's degree at Duke.

The course-seminar-research requirement in the doctoral program is a minimum of 60 units, but the proportions of course-seminar work and research are generally flexible, based on individual needs. Those applicants with master's degrees, after establishing quality work here, may be granted transfer credit to a maximum of 30 units, i.e., the equivalent of one year of residence. The dissertation is expected to be a mature and competent piece of writing, embodying the results of original and significant research. All dissertations will be published on microfilm, and the author may retain copyright privileges.

Time limitations are set for the completion of the doctoral program. The preliminary examination, which may be taken only after language, course-seminar, and residence requirements have been met, formally admits a student to candidacy for the degree. This examination should be passed by the end of the third year of doctoral study. The interval between preliminary examination and presentation of an acceptable dissertation should ordinarily be one to two years and may not be more than four years without special approval by the Dean. Should this interval extend beyond five years, a second preliminary examination usually becomes necessary.

Financial Information*

Tuition and fees are charged at the rate of \$141 per unit (a unit is equivalent to a semester hour), with the normal full program of study being 30 units for an academic year. Upon successful completion of the preliminary examination and two years of residence, the normal full program during the dissertation period is 3 units per semester while in residence, or 1 unit per semester while not in residence. The basic necessary expenses for a year of graduate study, assuming one lives in University graduate dormitories, are therefore approximately as follows:

*The figures contained in this section are subject to change prior to the beginning of the fall, 1979, semester.

	<i>First and Second Year</i>	<i>Dissertation Year</i>
Tuition	\$4,230	\$846
Health Fee	115	115
Room Rent* (Central Campus Apartments)	1,197	1,197
Board†	1,300	1,300

*Depending upon accommodations chosen.

†Cafeteria estimate

Additional allowances should be made for books, laundry, and other personal expenditures.

Apartment accommodations for graduate and professional students will be offered in two locations—in the recently completed Central Campus Apartments, and the Town House Apartments, both of which are conveniently located between East and West Campus. Efficiencies, one-bedroom, and three-bedroom apartments are available furnished or unfurnished. It is expected that many more applications will be received for these units than can be accommodated.

Financial Aid. In recent years at Duke about two-thirds of all full-time students have held an award of some type; about one-third of these were aided by Duke funds and the other two-thirds by funds from other sources.

The student who seeks financial aid from Duke University should be certain that the request for admission and award is filed not later than February 1 of the year in which September admission is sought. The application for admission, including transcripts of previous college work and letters of recommendation, is processed by the Graduate School and forwarded to the department in which the student wishes to pursue advanced work. The graduate faculty—or admissions committee—in the department reviews all applications and then makes its recommendation to the Dean for announcement in late March. The most outstanding applicants are then offered awards; the next in order of rank are placed on an alternate list for awards. Other students are offered only admission to the Graduate School. Because of multiple applications by students, a fraction of the awards offered by any graduate school are not accepted. Alternates on the award list are immediately notified, and the process continues until the desired number of awards has been made.

Awards to entering students at Duke are in the form of fellowships, scholarships, and assistantships. Students holding awards usually are paid in nine equal installments beginning in late September: tuition and room fees may be deducted monthly on a pro rata basis.

James B. Duke Graduate Fellowships are provided through a special endowment of the Duke Endowment. Fellows are chosen from nominations made by the departments. Only outstanding applicants who are seeking the Ph.D. degree are considered. These nominations are made in late February and are judged in a competition which includes candidates from all departments granting the Ph.D. degree. The fellowships provide for payment of tuition for full registration and a stipend of \$350 per month for the full calendar year during each of the three years of the award. The award requires no service beyond that which is required of all students in a given department as a part of their training and is renewable each year upon satisfactory progress toward the degree at a fellowship level of quality. The total value of a James B. Duke Fellowship over the full three years of tenure is over \$21,000 at current tuition rates.

Graduate Fellowships range in value to \$6,000 for the academic year and are made on a year-to-year basis. They are awarded upon recommendation by each department. No service is required as a prerequisite for accepting a fellowship, but all fellowship holders are expected to maintain full-time registration.

Special Graduate Fellowships for Minority Students provide for payment of tuition plus stipend for a total value of \$6,617. They are awarded for one year to qualified applicants upon the recommendation of the department.

Graduate Scholarships provide for payment of tuition or partial tuition. Full tuition scholarships are valued at \$4,230 for the academic year. Scholarships are awarded upon recommendation of each department.



Graduate Assistantships range in value to \$6,300 for the academic year. Assistants may be permitted to reduce their registration to 12 or 9 units, depending on the amount of service required. Residence credit as a full-time student is allowed under these circumstances. Assistantships are most common in the science departments, where the student often provides laboratory assistance to various members of the faculty. Most graduate assistants remain in residence during the summer sessions carrying research or course credit. In this way, the normal progress toward a degree is not impeded by the reduced load during the fall and spring semesters. Departmental research funds are often available to provide financial assistance during the summer.

Other graduate fellowships are available from foundations, industry, or the government. Among those at the University's disposal are Kearns fellowships in religion; Mellon fellowships and traineeships under a grant from the Office of Education for students in the Canadian Studies Program; Medieval and Renaissance Studies fellowships; and Cokesbury awards for the preparation for college teaching. In 1978-79, three students held Foreign Language Fellowships awarded by Duke University under Title VI of the National Defense Education Act in Southeast Asia Area Studies. Over 300 other traineeships and assistantships are available in the biological, physical, and social sciences under grants from the National Institutes of Health, National Institutes of Mental Health, National Science Foundation, research agencies in the Department of Defense, and other governmental agencies.

Loans. Students who anticipate the need to supplement their financial resources through loans should contact their state lending agencies. These agencies provide loans through the Federally Insured Student Loan Program. Some have application deadlines as early as April 1. A list of the state lending agencies with addresses is available upon inquiry to the graduate school office.

It is the policy of the Graduate School to provide loans through the University to help students meet their educational expenses. Only students with full-time status who meet the federal criteria for need but who are unable to obtain loans from their state agencies are eligible for loans through the University. Loan funds are provided through the Federally Insured Student Loan Program, the National Direct Student Loan Program, and funds solely under institutional control. Generally, loans made from these funds bear no interest charge to qualified borrowers while they maintain student status and for a short period thereafter. Interest during the repayment period is at a generally favorable rate. The amount of a loan through Duke for first year graduate students is usually limited to the amount of tuition. Eligibility requirements for Duke loans are the same as those for state agencies.

Inquiries concerning loans should indicate the department of intended matriculation and include all pertinent information concerning application to a state agency. These inquiries should be addressed to the Financial Aid Coordinator, Graduate School, Duke University, Durham, North Carolina 27706.

The costs of graduate education are high, but Duke University attempts to allocate its funds so that the superior student is able to finish work for a degree in the normal length of time regardless of personal financial resources. This is a contribution to the community of scholarship which the University is glad to bear.

The applicant who wishes further information on facilities and regulations on course programs not covered in this bulletin is invited to write to the Dean of the Graduate School, or the Director of Graduate Studies in the department of intended study.

Calendar of the Graduate School

Summer Session 1979

First Term: May 8-June 9
Second Term: June 11-July 13
Third Term: July 16-August 17

Academic Year 1979-1980

First Semester: September 4-December 20
Second Semester: January 8-May 1

August 27-29	Registration for First Semester
September 4	Classes Begin
November 20-25	Thanksgiving Recess
December 7-13	Reading Period*
December 20	End of First Semester
January 11	Registration for Second Semester
January 14	Classes Begin
March 8-16	Spring Recess
April 22-28	Reading Period*
May 5	End of Second Semester
May 11	Commencement

Special Deadlines for Admission Applications

July 15, 1979	Last day for completing application for admission to the Fall Semester.
November 1, 1979	Last day for completing application for admission to the Spring Semester.
February 1, 1980	Last day for completing application for admission and award to the Fall Semester.
April 15, 1980	Last day for completing application for admission to the First Summer Session.†
May 15, 1980	Last day for completing application for admission to the Second Summer Session.†
June 15, 1980	Last day for completing application for admission to the Third Summer Session.†

*For 200-level courses, the length of the reading period is at the discretion of the instructor.
†Students seeking admission to the Graduate School for study in the summer session should apply to the Dean of the Graduate School and to the Director of the Summer Session.

Advanced Degree Programs



COURSE OFFERINGS AND PROGRAM DESCRIPTIONS*

Anatomy

Professors

Sheila J. Counce, Ph.D.(Edinburgh); John Wendell Everett, Ph.D.(Yale), *Emeritus*; Montrose J. Moses, Ph.D.(Columbia); Talmage Lee Peele, M.D.(Duke), *Emeritus*; J. David Robertson, M.D.(Harvard), Ph.D.(Massachusetts Inst. of Tech.), *James B. Duke Professor of Anatomy and Chairman*.

Associate Professors

Matt Cartmill, Ph.D.(Chicago); Kenneth Lindsay Duke, Ph.D.(Duke); Harold Erickson, Ph.D.(Johns Hopkins); William C. Hall, Ph.D.(Duke), *Director of Graduate Studies*; William Hylander, Ph.D.(Chicago); Richard F. Kay, Ph.D.(Yale); William Longley, Ph.D.(London); Michael K. Reedy, M.D.(Washington).

Assistant Professors

Mark Adelman, Ph.D.(Chicago); Nell Cant, Ph.D.(Michigan); Joseph Corless, M.D., Ph.D.(Duke); Martin Joseph Costello III, Ph.D.(Duke); Emma Raff Jakoi, Ph.D.(Duke); Thomas J. McIntosh, Ph.D.(Carnegie-Mellon); Richard B. Marchase, Ph.D.(Johns Hopkins); Frederick H. Schachat, Ph.D.(Stanford); Timothy Strickler, Ph.D.(Chicago); Lee Tyrey, Ph.D.(Illinois).

Lecturer

Irving T. Diamond, Ph.D.(Chicago).

Adjunct Professor

Elwyn L. Simons, Ph.D.(Princeton), D.Phil.(University Coll., Oxford).

The Department of Anatomy offers graduate programs designed to produce teachers and research workers competent in a broad range of anatomical sciences; A.M. and Ph.D. degrees are offered. Students with a wide variety of backgrounds

*For full course descriptions including credit and name of instructor see the official, detailed *Bulletin of the Graduate School*

and interests in the biological sciences can be accommodated. All students participate in a core of anatomical science courses (Anatomy 305, 307, 309) and gain experience in teaching over the range of departmental interests. Students are encouraged to round out their formal course work by drawing upon the offerings of other departments in the University, as well as those in the anatomy department. Laboratories within the department are equipped for and actively support research in several areas. For further information contact the Director of Graduate Studies.

Courses of Instruction

207. Human Anatomy; 208. Anatomy of the Trunk; 214. Anatomy of the Head and Neck; 215. Contractile Processes; 216. Biological Psychology; 217. Structure and Function of Visual Photoreceptors; 219. Molecular and Cellular Bases of Development; 219S. Seminar; 231. Human Evolution; 238. Functional and Evolutionary Morphology of Primates; 240. Mechanisms of Biological Motility; 246. The Primate Fossil Record; 261. History of Generation and Mammalian Reproduction; 263. History of Anatomy; 264. Mammalian Embryology and Developmental Anatomy; 265S, 266S. Seminar in Chromosome Biology; 276. Neuroanatomical Basis of Sensory Physiology; 280. Structure and Assembly of Macromolecules; 286. The Light Microscope, the Electron Microscope, and X-ray Diffraction in Biology; 288S. The Cell in Development and Heredity; 299. Neuroanatomical Basis of Behavior; 300. Gross Anatomy; 305. Gross Human Anatomy; 307. Microscopic Anatomy; 309. Neuroanatomy; 312. Research; 313, 314. Anatomy Seminar; 340. Tutorial in Advanced Anatomy; 344. Advanced Neuroanatomy of Sensory and Motor Mechanisms; 354. Research Techniques in Anatomy; 418. Reproductive Biology.

Anthropology

Professors

Richard G. Fox, Ph.D.(Michigan), *Chairman*; Ernestine Friedl, Ph.D.(Columbia); Weston LaBarre, Ph.D.(Yale), *James B. Duke Professor Emeritus of Anthropology*; Elwyn L. Simons, Ph.D.(Princeton), D.Phil.(University Coll., Oxford).

Associate Professors

Mahadev L. Apte, Ph.D.(Wisconsin); Matt Cartmill, Ph.D.(Chicago); William Hylander, Ph.D.(Chicago); William M. O'Barr, Ph.D.(Northwestern); Naomi R. Quinn, Ph.D.(Stanford), *Director of Graduate Studies*; Carol A. Smith, Ph.D.(Stanford); Carol Stack, Ph.D.(Illinois).

Assistant Professors

Kenneth E. Glander, Ph.D.(Chicago); Teresa Graedon, Ph.D.(Michigan); W. Michael Hammond, Ph.D.(Columbia); Patricia R. Pessar, Ph.D.(Chicago).

Adjunct Assistant Professor

Richard F. Kay, Ph.D.(Yale).

The department offers graduate work leading to the Ph.D. degree in anthropology. Applicants for admission should submit scores on the Graduate Record Examination Aptitude Test. Admission to the program is not contingent on previous anthropological course work or any other specific program of study at the undergraduate level.

Candidates for the Ph.D. degree must demonstrate knowledge of the broad issues and perspectives that unify anthropology, and competence in their chosen

subfield of specialization. The department offers a program of specialization in social/cultural anthropology and a program of specialization in physical anthropology. The emphasis of the social/cultural anthropology program is the application of a cross-cultural and comparative perspective to research in complex societies. The emphasis of the physical anthropology program is primate evolution; areas of concentration include comparative morphology of human and nonhuman primates, and primate social behavior.

Curriculum is tailored to the individual student's specific background, needs, and research goals; relevant cross-disciplinary study is encouraged. However, there are a modest number of required courses for students in both programs. All students must participate in Anthropology 291 and 330-331 (on the evolution of human society) and demonstrate competence in statistics and at least one foreign language. In addition, students in the physical anthropology program must complete Anthropology 244, 246, and 305, or acceptable course substitutions.

Further details of the graduate program in anthropology, the departmental facilities, the staff, and various stipends available are described in the *Guidelines for Graduate Students in Anthropology* which may be obtained from the Director of Graduate Studies, Department of Anthropology.

Courses of Instruction

211S. Ethnography of Communication; 220S. Society and Culture in India; 222. Topics in African Anthropology; 234S. Political Economy of Development: Theories of Change in the Third World; 242S. Topics in Prehistory; 243S. Theory and Method in Archaeology; 244S. Primate Behavior; 245. Functional and Evolutionary Morphology of Primates; 246. The Primate Fossil Record; 249S. Topics in Economic Anthropology; 251. Ethnography of Humor; 258S. Symbols in Society; 264. Anthropological Approaches to Religion; 267. Cognitive Anthropology; 270. Ethnographic Field Methods; 271. Methods of Data Analysis; 275. Rank, Power, and Authority in Preindustrial Societies; 276S. Topics in Kinship; 277. Class, Ethnicity, and Public Policy; 278S. Topics in Political Anthropology; 280S, 281S. Seminar in Selected Topics; 282S. Seminar on Canada; 291, 292. Anthropological Theory; 330, 331. Seminar in Anthropology; 334. Topics in Physical Anthropology; 335, 336. Linguistic Theory and Methods; 393. Individual Research in Anthropology; 402. Interdisciplinary Seminar in the History of the Social Sciences; 410. Seminar in the Government, History, and Social Structure of India and Pakistan.

Art

Professors

Sidney David Markman, Ph.D.(Columbia); John R. Spencer, Ph.D.(Yale), *Chairman and Director of Graduate Studies*; Elizabeth Read Sunderland, Ph.D.(Radcliffe).

Assistant Professors

John L. Connolly, Jr., Ph.D.(Pennsylvania); Rona Goffen, Ph.D.(Columbia); Duncan T. Kinkead, Ph.D.(Michigan).

Graduate work in the Department of Art is offered leading to the A.M. degree in art history and is designed to provide basic training in the history of art with specialization in a given field selected by the student after consultation with and approval of the Director of Graduate Studies. Prospective students should present a minimum of 24 semester hours of undergraduate work in the history of art. In special cases a student who does not fulfill this prerequisite may be required to attend prescribed undergraduate courses. A reading knowledge of one foreign

language (preferably German) is required; candidates who do not meet this requirement upon admission to the program are expected to do so by the end of their first term in residence.

The program for the A.M. degree in art history consists of 30 units as follows: 12 units in art history; 6 units in an approved minor; 6 units in the major or minor, or other approved subject; and 6 units in thesis. A written thesis is required. Candidates must also pass written comprehensive examinations testing their knowledge of art history and pertinent bibliographical resources.

Courses of Instruction

233. Early Medieval Architecture; 238S. Studies in Italian Renaissance Art; 240. Spanish Baroque Painting; 244. Problems in Nineteenth-Century Art; 249. Problems in Pre-Columbian Art and Archaeology; 250. Problems in Latin American Art; 254. Problems in Modern Architecture; 257. Problems in Modern European Art; 291S. Methods in Art History; 293, 294. Special Problems in Art History.

Asian Languages

The courses are offered as an enrichment for students interested in the South Asian subcontinent and may be taken as a general elective by advanced undergraduate students. No major work is offered in Hindi-Urdu.

Hindi-Urdu 200-201. Special Studies in South Asian Languages; Hindi-Urdu 203. Studies in Commonwealth Literature.

For courses in Chinese and Japanese, see *Bulletin of Undergraduate Instruction*.

Biochemistry

Professors

Irwin Fridovich, Ph.D.(Duke); Samson R. Gross, Ph.D.(Columbia); Walter R. Guild, Ph.D.(Yale), Director of the Genetics Division; Philip Handler, Ph.D.(Illinois);* Robert Hill, Ph.D.(Kansas), *James B. Duke Professor of Biochemistry and Chairman*; Henry Kamin, Ph.D.(Duke); Norman Kirshner, Ph.D.(Pennsylvania State); Kenneth S. McCarty, Ph.D.(Columbia); K. V. Rajagopalan, Ph.D.(Univ. of Madras); Charles Tanford, Ph.D.(Princeton), *James B. Duke Professor of Biochemistry*; Robert E. Webster, Ph.D.(Duke).

Associate Professors

Robert Bell, Ph.D.(California at Berkeley); Ronald C. Greene, Ph.D.(California Inst. of Tech.); Bernard Kaufman, Ph.D.(Indiana); Sung-Hou Kim, Ph.D.(Pittsburgh); William Sanford Lynn, Jr., M.D.(Columbia); Jacqueline A. Reynolds, Ph.D.(Washington); David C. Richardson, Ph.D.(Massachusetts Inst. of Tech.), *Director of Graduate Studies*; Harvey J. Sage, Ph.D.(Yale); Lewis M. Siegel, Ph.D.(Johns Hopkins); James B. Sullivan, Ph.D.(Texas).

Assistant Professors

Arno L. Greenleaf, Ph.D.(Harvard); Robert L. Habig, Ph.D.(Purdue); Edward W. Holmes, M.D.(Pennsylvania); Nicholas M. Kredich, M.D.(Michigan); Robert J. Lefkowitz, M.D.(Columbia); P. A. McKee, M.D.(Oklahoma); Paul L. Modrich, Ph.D.(Stanford); Salvatore V. Pizzo, Ph.D.(Duke); Allen D. Roses, M.D.(Pennsyl-

*On leave of absence.

vania); Deborah A. Steege, Ph.D.(Yale); Robert W. Wheat, Ph.D.(Washington Univ.).

Associates

John A. Bittikofer, Ph.D.(Purdue); Yasuhiko Nazaki, Ph.D.(Univ. of Tokyo).

Assistant Medical Research Professors

Celia Bonaventura, Ph.D.(Texas); Joseph Bonaventura, Ph.D.(Texas).

Graduate work in the Department of Biochemistry is offered leading to the Ph.D. degree. Preparation for such graduate study may take diverse forms. Undergraduate majors in chemistry, biology, mathematics, or physics are welcome, but adequate preparation in chemistry is essential. Graduate specialization areas include protein structure and function, crystallography of macromolecules, nucleic acid structure and function, lipid biochemistry, membrane structure and function, molecular genetics, enzyme chemistry, and neurochemistry. The division of genetics of the department, in cooperation with the University Program in Genetics, offers biochemistry students the opportunity to pursue advanced research and study to fulfill the requirements for the Ph.D. degree.

Courses of Instruction

209-210. Independent Study; 216. Molecular Genetics; 219. Molecular and Cellular Bases of Development; 219L. Laboratory; 219S. Seminar; 220. Adaptations of Organisms to the Marine Environment; 222. Structure of Biological Macromolecules; 224. Biochemistry of Development and Differentiation; 227. Introductory Biochemistry I: Intermediary Metabolism; 228. Introductory Biochemistry II: Molecular Biology; 241. General Biochemistry; 265S, 266S. Seminar; 276. Comparative and Evolutionary Biochemistry; 282. Experimental Genetics; 284. Current Topics in Genetic Mechanisms; 286. Current Topics in Immunochemistry; 288. The Carbohydrates and Lipids of Biological Systems; 291. Physical Biochemistry; 292. Proteins and Enzymes; 296. Biological Oxidations; 297. Intermediary Metabolism; 299. Nutrition; 302. Neurochemistry; 305. Nucleic Acids; 345, 346. Biochemistry Seminar; 351, 352. Genetics Seminar; 390. Biochemistry of Membranes.

Botany

Professors

Lewis Edward Anderson, Ph.D.(Pennsylvania); Janis Antonovics, Ph.D.(Univ. Coll. of North Wales); William Dwight Billings, Ph.D.(Duke); *James B. Duke Professor of Botany*; John E. Boynton, Ph.D.(California at Davis); William Lewis Culberson, Ph.D.(Wisconsin); Henry Hellmers, Ph.D.(California at Berkeley); Terry W. Johnson, Jr., Ph.D.(Michigan); Aubrey Willard Naylor, Ph.D.(Chicago), *James B. Duke Professor of Botany*; Jane Philpott, Ph.D.(Iowa); Donald E. Stone, Ph.D.(California at Berkeley); Boyd R. Strain, Ph.D.(California at Los Angeles), *Director of Graduate Studies*; Richard A. White, Ph.D.(Michigan), *Chairman*; Robert L. Wilbur, Ph.D.(Michigan).

Associate Professors

Richard T. Barber, Ph.D.(Stanford); Kenneth R. Knoerr, Ph.D.(Yale); Richard B. Searles, Ph.D.(California at Berkeley).

Assistant Professors

Norman L. Christensen, Jr., Ph.D.(California at Santa Barbara); Joseph S. Ramus, Ph.D.(California at Berkeley); James N. Siedow, Ph.D.(Indiana).

Lecturer

C. F. Culberson, Ph.D.(Duke).

Graduate work in the Department of Botany is offered leading to the A.M. (nonthesis), M.S. (thesis), and Ph.D. degrees. Before undertaking graduate study in botany a student should have had in the undergraduate program at least 12 semester hours of botany beyond an elementary course, and related work in biological sciences. Some work in chemistry and physics will be desirable and, for some phases of botanical study, a necessity. The student's graduate program is planned to provide a broad basic training in the various fields of botany, plus intensive specialization in the field of the research problem.

Courses of Instruction

203. Cytogenetics; 203L. Cytogenetics; 204L. Marine Microbiology; 207L. Microclimatology; 209L. Lichenology; 210L. Bryology; 211L. Marine Phycology; 212L. Phycology; 214L. Biological Oceanography; 215. Phytoplankton; 216. Photosynthetic Physiology of Marine Plants; 217L. Environmental Instrumentation; 218. Barrier Island Ecology; 221L. Mycology; 225T, 226T. Special Problems; 227. Introductory Biochemistry I: Intermediary Metabolism; 228. Introductory Biochemistry II: Molecular Biology; 233L. Microbiology; 235. Evolutionary Systematics; 235L. Evolutionary Systematics; 236S. Major Global Ecosystems; 242L. Systematics; 244L. Diversity of Plants; 245L. Plant Diversity; 246L. Ecology of Plants; 247L. Plant Ecology; 250L, S. Plant Biosystematics; 251L. Plant Physiology; 252S. Plant Metabolism; 253. Advanced Plant Physiology; 256. Physiological Role of Minerals and Water; 257S. Principles of Plant Distribution; 258. Physiology of Growth and Development; 260L. Plant Anatomy; 261. Photosynthesis; 265. Physiological Plant Ecology; 265L. Physiological Plant Ecology; 267L. Plant Community Ecology; 280. Principles of Genetics; 280L. Principles of Genetics; 283. Extrachromosomal Inheritance; 285S. Ecological Genetics; 286. Evolutionary Mechanisms; 287S. Quantitative Genetics; 295S, 296S. Seminar; 300. Tropical Biology: An Ecological Approach; 305. Tropical Studies; 344S. Micrometeorology and Biometeorology Seminar; 359-360. Research in Botany.

Business Administration

Professors

Helmy Baligh, Ph.D.(California at Berkeley); Kalman J. Cohen, Ph.D.(Carnegie-Mellon); John D. Forsyth, D.B.A.(Illinois); W. Clay Hamner, D.B.A.(Indiana); Thomas F. Keller, Ph.D.(Michigan), *R. J. Reynolds Industries Professor of Business Administration, Dean*; Dan J. Laughhunn, D.B.A.(Illinois); Arie Y. Lewin, Ph.D.(Carnegie-Mellon); Richard C. Morey, Ph.D.(California at Berkeley); David W. Peterson, Ph.D.(Stanford).

Associate Professors

Kenneth R. Baker, Ph.D.(Cornell); Joseph Battle, Ph.D.(Michigan); Richard M. Burton, D.B.A.(Illinois); David C. Dellinger, Ph.D.(Stanford); David A. Dittman, Ph.D.(Ohio State); Joel C. Huber, Ph.D.(Pennsylvania); John S. Hughes, Ph.D.(Purdue); Roy J. Lewicki, Ph.D.(Columbia); Steven F. Maier, Ph.D.(Stan-

ford); John M. McCann, Ph.D.(Purdue); Bruce M. Owen, Ph.D.(Stanford); John William Payne, Ph.D.(California at Irvine); James H. Vander Weide, Ph.D.(Northwestern).

Assistant Professors

David Alan Collier, Ph.D.(Ohio State); Mark R. Eaker, M.B.A., Ph.D.(Stanford); Jose A. Espejo, Ph.D.(Columbia); Lawrence Kessler, Ph.D.(California at Berkeley); Wesley A. Magat, Ph.D.(Northwestern); Mary F. Mericle, Ph.D.(North Carolina at Chapel Hill); Gary S. Monroe, Ph.D.(Massachusetts); Robert E. Taylor, Ph.D.(North Carolina at Chapel Hill).

The Graduate School of Business Administration offers work leading to the M.B.A. and Ph.D. The programs of study leading to the first degree are described in the *Bulletin of the Graduate School of Business Administration*. The Ph.D. program is designed for students who desire to enter either the academic profession or advanced and specialized administrative research positions. The program accepts students with bachelor's degree preparation and normally requires three to four years.

One year of study (30 units) beyond completion of the Duke M.B.A. degree or its equivalent is planned for each doctoral candidate. The year of study should include two courses in advanced economic theory, two courses in mathematics or statistics, and three courses in an elected field of administration. The latter are individually designed and are offered on a tutorial basis to provide extensive reading in the historical and current literature, and a demanding research program.

The requirements of the Graduate School are applicable to students in the Ph.D. program in business administration.

Management science courses open only to students in health administration are listed under the Department of Health Administration.

Refer to the *Bulletin of the Graduate School of Business Administration* for a complete list of courses and course descriptions.

Courses of Instruction

309.1-9. Research in Managerial Economics; 319.1-9. Research in Quantitative Methods; 329.1-9. Research in Organization Theory and Management; 339.1-9. Research in Information and Accounting Systems; 349.1-9. Research in Public Policy and Social Responsibility; 359.1-9. Research in Finance; 369.1-9. Research in Marketing; 379.1-9. Research in Production; 392-393. Tutorial in Interdisciplinary Areas; 397. Dissertation Research.

Chemistry

Professors

Charles Kilgo Bradsher, Ph.D.(Harvard), *James B. Duke Professor of Chemistry*; Donald B. Chesnut, Ph.D.(California Inst. of Tech.); Marcus Edwin Hobbs, Ph.D.(Duke), *University Distinguished Service Professor of Chemistry*; Peter W. Jeffs, Ph.D.(Natal), *Director of Graduate Studies*; William R. Krigbaum, Ph.D.(Illinois) *James B. Duke Professor of Chemistry and Chairman*; Andrew T. McPhail, Ph.D.(Glasgow); Richard A. Palmer, Ph.D.(Illinois); Jacques C. Poirier, Ph.D.(Chicago); Louis DuBose Quin, Ph.D.(North Carolina at Chapel Hill); Peter Smith, Ph.D.(Cambridge); Howard Austin Strobel, Ph.D.(Brown); Richard L. Wells, Ph.D.(Indiana); Pelham Wilder, Jr., Ph.D.(Harvard).

Associate Professors

Steven Baldwin, Ph.D.(California Inst. of Tech.); Alvin L. Crumbliss, Ph.D.(Northwestern); Robert W. Henkens, Ph.D.(Yale); Charles H. Lochmüller, Ph.D.(Fordham); Ned Allen Porter, Ph.D.(Harvard).

Assistant Professors

C. William Anderson, Ph.D.(Cincinnati); William L. Luken, Jr., Ph.D.(Yale); Barbara R. Shaw, Ph.D.(Washington).

Adjunct Associate Professor

Colin G. Pitt, Ph.D.(London).

In the Department of Chemistry graduate work is offered leading to the A.M. and Ph.D. degrees. Before undertaking a graduate program in chemistry, a student should have taken an undergraduate major in chemistry, along with related work in mathematics and physics.

Graduate courses in the department are offered in the fields of analytical, inorganic, organic, and physical chemistry. Research programs are active in all these fields.

A booklet providing detailed information on the department is available from the Director of Graduate Studies.

Courses of Instruction

201. Molecular Spectroscopy; 203. Quantum Chemistry; 205. Structure and Reaction Dynamics; 207. Principles of Thermodynamics, Diffraction, and Kinetics; 230. Environmental Oceanography; 240. Chemical Oceanography; 275, 276. Advanced Studies; 300. Basic Statistical Mechanics; 302. Basic Quantum Mechanics; 303, 304. Special Topics in Physical Chemistry; 310. Theoretical and Structural Inorganic Chemistry; 312. Inorganic Reactions and Mechanisms; 313, 314. Special Topics in Inorganic Chemistry; 320. Synthetic Organic Chemistry; 322. Organic Reactive Intermediates; 323, 324. Special Topics in Organic Chemistry; 330. Chemical Separation Methods and Kinetics in Analytical Chemistry; 331, 332. Special Topics in Analytical Chemistry; 334. Chemical Instrumentation and Applied Spectroscopy; 373, 374. Seminar; 375, 376. Research; 377. Research Orientation Seminar.

Classical Studies

Professors

Francis Newton, Ph.D.(North Carolina at Chapel Hill); John F. Oates, Ph.D.(Yale), *Chairman*; Lawrence Richardson, Jr., Ph.D.(Yale), F.A.A.R., *James B. Duke Professor of Latin in Classical Studies*; William H. Willis, Ph.D.(Yale).

Associate Professors

Peter H. Burian, Ph.D.(Princeton); Kent J. Rigsby, Society of Fellows (Harvard), *Director of Graduate Studies*; Dennis Keith Stanley, Jr., Ph.D.(Johns Hopkins).

Assistant Professor

John G. Younger, Ph.D.(Cincinnati).

Visiting Professor

Harry L. Levy, Ph.D.(Columbia).

The Department of Classical Studies offers two programs leading to the Ph.D. degree, one with emphasis on literature and philology, the other with emphasis on

ancient history and archaeology. For regular admission to the program in literature and philology, a student must offer three years of college study above the elementary level in one of the classical languages and two college years in the other. Students wishing to enter the program in ancient history and archaeology will be required on entrance to demonstrate satisfactory competence in both Greek and Latin for reading in the primary sources; failure to demonstrate such competence will require modification of the student's program to repair the deficiency.

The department's special requirements, in addition to the general requirements of the University for the Ph.D. degree set forth in the section on Program Information of this bulletin, are presented in a sheet that may be obtained from the Director of Graduate Studies. They include special requirements in seminars, course work, and the preliminary examination for the Ph.D. degree.

A reading knowledge of German and French is required of all candidates for the Ph.D. degree. The candidate should meet one of the language requirements by the end of the first term in residence and the other by the end of the third term.

Under the terms of a cooperative agreement, graduate students of Duke University may, with the approval of the chairman of their major department and upon payment of a nominal fee, take any graduate course offered by the Department of Classics of the University of North Carolina. A list of these courses will be sent upon request.

Courses of Instruction

GREEK

200. Graduate Reading; 203. Homer; 205. Greek Lyric Poets; 206. Aeschylus; 208. Sophocles; 209. Euripides; 210. Aristophanes; 221. Early Greek Prose; 222. Thucydides; 223. Greek Orators I; 224. Greek Orators II; 225. Plato; 231. Hellenistic Poetry; 241. Advanced Prose Composition; 301. Greek Seminar I; 302. Greek Seminar II; 303. Greek Seminar III; 304. Greek Seminar IV; 305. Greek Seminar V; 306. Greek Seminar VI; 311. Proseminar in Papyrology; 313. Proseminar in Greek Epigraphy; 321. Seminar in Literary Papyri; 323. Seminar in Documentary Papyri; 399. Directed Reading and Research.

LATIN

200. Graduate Reading; 201. The Verse Treatise; 202. Roman Satire; 203. Epic: Vergil; 204. Epic: Lucan and Statius; 207. The Prose Epistle; 208. The Epistle in Verse; 209. Fragments of Early Latin; 210. Lyric and Occasional Poetry; 211. Roman Oratory I; 212. Roman Oratory II; 221. Medieval Latin I; 222. Medieval Latin II; 225. Latin Paleography; 241. Advanced Latin Composition; 250. Teaching Latin; 301. Latin Seminar I; 302. Latin Seminar II; 303. Latin Seminar III; 304. Latin Seminar IV; 305. Latin Seminar V; 306. Latin Seminar VI; 312. Proseminar in Latin Paleography; 314. Proseminar in Latin Epigraphy; 315. Proseminar in Roman Law; 399. Directed Reading and Research.

CLASSICAL STUDIES

301. Introduction to Classical Philology I; 302. Introduction to Classical Philology II; 351. The Teaching of Classics.

CLASSICAL STUDIES (ANCIENT HISTORY)

253. Greece to the Orientalizing Period; 254. The Age of the Tyrants and the Persian Wars; 255. The Age of Pericles; 256. The Fourth Century through

Alexander; 257. Social and Cultural History of the Hellenistic World from Alexander to Augustus; 258. Social and Cultural History of the Graeco-Roman World; 260. The History of Rome to 146 B.C; 261. The Roman Revolution, 146-30 B.C; 262. Rome under the Julio-Claudians; 263. From the Flavian Dynasty to the Severan; 264. From Septimius Severus to Constantine; 270. The Rise of the Hellenistic Kingdoms; 271. The Hellenistic World, 250-31 B.C; 321. Seminar in Ancient History I; 322. Seminar in Ancient History II; 323. Seminar in Ancient History III; 324. Seminar in Ancient History IV; 325. Seminar in Ancient History V; 326. Seminar in Ancient History VI; 327. Seminar in Byzantine History; 399. Directed Reading and Research.

CLASSICAL STUDIES (ARCHAEOLOGY)

231S. Greek Sculpture; 232S. Greek Painting; 235S. Roman Architecture; 236S. Roman Painting; 311. Archaeology Seminar I; 312. Archaeology Seminar II.

Comparative Literature

No graduate degree is offered in comparative literature. The following courses may serve, however, in the minor programs of students in other departments. Consult Professor Rolleston in the Department of Germanic Languages.

220S. Comparative Literature Seminar; 280. Literary Criticism; 399. Special Readings.

Computer Science

Professors

Thomas M. Gallie, Ph.D.(Rice); Donald W. Loveland, Ph.D.(New York Univ.); Peter N. Marinos, Ph.D.(North Carolina State); Thomas H. Naylor, Ph.D.(Tulane); Merrell L. Patrick, Ph.D.(Carnegie Inst. of Tech.), *Chairman*; Charles Starmer, Ph.D.(North Carolina at Chapel Hill); Max A. Woodbury, Ph.D.(Michigan).

Associate Professors

Alan W. Biermann, Ph.D.(California at Berkeley), *Director of Graduate Studies*; Alexandre Brandwajn, Ph.D.(Paris VI); Dietolf Ramm, Ph.D.(Duke); Robert A. Wagner, Ph.D.(Carnegie-Mellon).

Assistant Professor

Kishor S. Trivedi, Ph.D.(Illinois).

Adjunct Professor

Leland Williams, Ph.D.(Duke).

The Department of Computer Science offers programs leading to the A.M. and Ph.D. degrees.

A student entering graduate work in computer science should have a knowledge of mathematics through advanced calculus, of data structures, and of assembler as well as higher level computer programming languages. Research interests of present faculty include mathematical foundations of computer science, artificial intelligence, program verification, programming languages, real-time computing, operating systems, information storage and retrieval, computer design, simulation of systems of interest to social scientists, and numerical analysis.

Courses of Instruction

200. Programming Methodology I; 201. Programming Languages; 207. Fault-Tolerant Computer Systems; 208. Digital Computer Design; 215. Artificial Intelligence; 221. Numerical Analysis I; 222. Numerical Analysis II; 224. Logic and Algorithms; 225. Formal Languages and Theory of Computation; 226. Mathematical Methods for Systems Analysis I; 227. Mathematical Methods for Systems Analysis II; 231. Introduction to Operating Systems; 232. Compiler Construction; 241. Data Base Management Systems; 244. Decision Models of the Firm; 250. Clustering and Classification; 252. Computer Systems Organization; 265. Advanced Topics in Computer Science; 301. Topics in Programming Theory; 308. Advanced Topics in Digital Systems; 315. Advanced Artificial Intelligence; 321. Topics in Numerical Mathematics; 325. Theory of Computation; 326. Systems Modeling; 331. Operating Systems Theory; 332. Topics in Operating Systems; 344. Workshop on Computer Models of Social Systems.

Economics

Professors

John Oliver Blackburn, Ph.D.(Florida), C.P.A.; Martin Bronfenbrenner, Ph.D.(Chicago), *William R. Kenan, Jr. Professor of Economics*; David George Davies, Ph.D.(California at Los Angeles); Craufurd David Goodwin, Ph.D.(Duke); Henry Grabowski, Ph.D.(Princeton); Daniel A. Graham, Ph.D.(Duke); Allen C. Kelley, Ph.D.(Stanford), *Chairman*; Juanita Morris Kreps, Ph.D.(Duke), *James B. Duke Professor of Economics*;* Harold Gregg Lewis, Ph.D.(Chicago); Thomas Herbert Naylor, Ph.D.(Tulane); Lloyd Blackstone Saville, Ph.D.(Columbia); Edward Tower, Ph.D.(Harvard); Vladimir G. Treml, Ph.D.(North Carolina at Chapel Hill); John M. Vernon, Ph.D.(Massachusetts Inst. of Tech.); Thomas D. Wallace, Ph.D.(Chicago); Elliot Roy Weintraub Ph.D.(Pennsylvania), *Director of Graduate Studies*; William Poe Yohe, Ph.D.(Michigan).

Associate Professors

Neil de Marchi, Ph.D.(Australian National Univ.); Stefano Fenoaltea, Ph.D.(Harvard); Thomas M. Havrilesky, Ph.D.(Illinois); Marjorie McElroy, Ph.D.(Northwestern).

Assistant Professors

Bruce R. Bolnick, Ph.D.(Yale); Robert Franklin Conrad, Ph.D.(Wisconsin); Philip J. Cook, Ph.D.(California at Berkeley); Joseph Lipscomb, Jr., Ph.D.(North Carolina at Chapel Hill); George E. Tauchen, Ph.D.(Minnesota); John A. Weymark, A.M.(Pennsylvania).

The Department of Economics offers graduate work leading to the A.M. and Ph.D. degrees. Among the undergraduate courses of distinct advantage to the graduate student in economics are statistics, economic theory, and basic courses in philosophy, mathematics, and social sciences other than economics. Advanced work in mathematics or statistics is also useful.

Requirements for the Ph.D. degree in economics include courses in economic theory in the first year, and at the end of the second year, an examination in economic analysis. In addition, a student must obtain certification in three fields, one of which may be in an outside minor. The student may select from advanced economic theory, history of political economy, economic development, economic

*On leave of absence.

history, international economics, money and banking, labor economics, public finance, industrial organization, econometrics, statistics, Soviet economics, and certain fields outside the economics department (e.g., demography). Course work for the Ph.D. degree should be completed in five semesters of residence.

Courses of Instruction

200. Capitalism and Socialism; 204S. Advanced Money and Banking; 231S. Analytical Economic History; 232. Economic History of Japan; 233. State and Urban Finance; 237, 238. Statistical Methods; 243. Econometrics I; 244. Decision Models of the Firm; 245. Econometrics II; 246. Selected Topics in Econometric Theory; 257. Manpower and Human Resources; 262. Trade Unionism and Collective Bargaining; 265S. International Trade and Finance; 282S. Seminar on Canada; 287. Public Finance; 293. Soviet Economic History; 294S. Soviet Economic System; 301. Microeconomic Analysis I; 302. Microeconomic Analysis II; 303. Theory of Economic Decision Making; 304, 305. Monetary Theory and Policy; 307. Quantitative Analysis I; 308. Quantitative Analysis II; 311, 312. History of Political Economy; 313, 314. Seminar in Economic Theory; 316. Seminar in Economics of Soviet-Type Socialism; 317. Seminar in Demographic, Population, and Resource Problems; 318. Dissertation Seminar; 319. Seminar in the Theory and the Problems of Economic Growth and Change; 320. Macroeconomic Analysis I; 321. Theory of Quantitative Economic Policy; 322. Macroeconomic Analysis II; 323. Income Distribution Theory; 329. Federal Finance; 330. Seminar in Public Finance; 331. Seminar in Economic History; 344. Applied Econometric Modeling; 345, 346. Demographic Techniques I and II; 350. Seminar in Applied Economics; 355. Seminar in Labor Economics; 358. Seminar in Labor Market and Related Analysis; 365. Seminar in International Trade Theory; 366. Seminar in International Monetary Theory; 388. Industrial Organization; 389. Seminar in Industrial and Governmental Problems; 397, 398. Directed Research; 401. Seminar on the British Commonwealth; 402. Interdisciplinary Seminar in the History of the Social Sciences.

Education

Professors

Anne H. Adams, Ed.D.(Mississippi); Peter F. Carbone, Ed.D.(Harvard), *Director of Graduate Studies*; William H. Cartwright, Ph.D.(Minnesota); Anne Flowers, Ed.D.(Duke), *Chairman*; W. Scott Gehman, Jr., Ph.D.(Pennsylvania State); Everett H. Hopkins, A.M.(Pennsylvania), LL.D.; Robert A. Pittillo, Jr., Ed.D.(Duke), *Associate Chairman*.

Associate Professors

Robert H. Ballantyne, Ed.D.(Washington State); Robert Merle Colver, Ed.D.(Kansas); Lucy T. Davis, Ed.D.(Columbia); Joseph DiBona, Ph.D.(California at Berkeley); Charles B. Johnson, Ed.D.(Duke); David J. Kuhn, Ph.D.(Purdue); David V. Martin, Ed.D.(Duke); Robert N. Sawyer, Ed.D.(Wyoming).

Assistant Professor

Michael L. Michlin, Ph.D.(Minnesota).

Lecturer

John A. Fowler, M.D.(Bowman Gray).

Graduate work in education is offered leading to the A.M., the M.Ed., the M.A.T., the Ed.D., and the Ph.D. degrees. For each of these degrees there are

specific requirements and prerequisites, all of which may be found stated in detail in this bulletin. Departmental requirements and prerequisites for all of these degrees, and for the sixth-year Program for Elementary and Secondary Teachers, may be obtained from the Director of Graduate Studies.

From the courses listed below, plus several in related disciplines, a selection may be made which will meet North Carolina requirements for the Advanced Principal's Certificate, the Superintendent's Certificate, and the Supervisor's Certificate.

(Some courses below are offered only in the summer session; see the *Bulletin of the Summer Session*.)

These programs are accredited by the National Council for Accreditation of Teacher Education for the preparation of elementary and secondary school teachers and school service personnel with the doctor's degree as the highest degree approved.

Courses of Instruction

201. Mathematics Program in the Elementary School; 202. Comparative and International Education: Industrialized Nations; 203. Seminar in Philosophical Analysis of Educational Concepts; 204. Educational Organization; 205. Selected Topics; 206. Studies in the History of Educational Philosophy; 207. Social History of Twentieth-Century American Education; 209S. John Dewey; 210. The Politics of Education; 213. Elementary School Organization and Administration; 215S. Secondary Education: Principles; 216. Secondary Education: Internship; 217. The Psychological Principles of Education; 218S. Comparative and International Education: Developing Societies; 219. Comparative and International Education: South Asia; 221. Programs in Early Childhood Education; 222. New Developments in Elementary School Curriculum; 223. Teaching the Language Arts; 224. Teaching the Social Studies in Elementary Schools; 225. The Teaching of History and the Social Studies; 226. Teaching Developmental and Remedial Reading in the Elementary School; 229. Assessments of Reading Disability Cases; 230. Research Methodology in Education; 232. Psycho-Educational Counseling with Families; 233. Improvement of Instruction in English; 234. Secondary School Organization and Administration; 236. Teaching Developmental and Remedial Reading in the Secondary School; 237. Teaching of Literature in Secondary Schools; 238. Content, Supervision, and Administration of Reading Programs; 239. Teaching of Grammar, Composition, Mechanics, and Usage in Secondary School; 240. Career Development; 241. Foundations of Counseling and Personnel Services; 243. Personality Dynamics; 244. Counseling Techniques; 245. Theories of Counseling; 246. Teaching of Mathematics; 247. Practicum in Guidance and Counseling; 248. Practicum in Counseling; 249. Exceptional Children; 250, 251. Teaching Emotionally Disturbed Children: Internship; 253. Introduction to Law and Education; 254. Law and Higher Education; 255. Assessment of Abilities; 256. Classroom Assessment of Student Achievement; 258. Assessment of Personality, Interests, and Attitudes; 259. Problems in Law and Education; 260. Educational Research I; 261. Educational Research II; 262. Educational Research III; 266. Basic Science for Teachers; 268. Seminar in Contemporary Educational Criticism; 270. Junior and Community College; 271. Instructional Systems for College and University Teaching; 272. Teaching Communication Skills in Early Childhood Education; 273, 274. Clinical Reading Practicum; 276. The Teaching of High School Science; 285. Audiovisual Aids in Education; 291. Public and Community Relations of Schools; 300. Individual Assessment of Intelligence; 301. Advanced Individual Assessment of Cognitive Abilities; 302. Seminar in Educational Research; 303. Diagnostic and Educational Programs in Learning Disabilities; 304. Internship in School Psychol-

ogy; 305. Personality Assessment: Projective Techniques; 309. Seminar on Higher Education in the United States; 310. Seminar in Higher Educational Administration; 311. Group Counseling; 313. Seminar in Education and Public Policy; 314. Seminar in Guidance and Counseling; 315. Seminar in Secondary School Teaching; 316, 317. Practicum in Higher Educational Research and Development; 321. Educational Management; 322. Planning and Management of Educational Facilities; 323. Public School Finance; 326. Educational Psychology: The Problem Child; 332. Supervision of Instruction; 335, 336. Seminar in School Administration; 337. Seminar in Community College Organization; 338. Seminar in Educational Supervision; 339. Seminar in Curriculum; 340. Seminar in Social Studies Curriculum; 341. Seminar in Elementary School Curriculum; 342. Seminar in Secondary School Curriculum; 343. History of Higher Education in America; 344. Research in Higher Education; 345. Seminar in Reading Instruction and Research; 346. Seminar in Organization of Preservice and Inservice Reading Programs; 347. Student Personnel Services in Higher Education; 348, 349. Seminar in Child Psychopathology; 350, 351. Directed Activities in Education; 357. Directed Research; 360. Seminar on Instructional Strategies.

Engineering

The School of Engineering offers programs of study and research leading to the degrees of Master of Science and Doctor of Philosophy with a major in biomedical, civil, or electrical engineering, or in mechanical engineering and materials science. These programs are designed to provide a fundamental understanding of the engineering sciences, which are based on mathematics and the physical sciences, and to develop experience in the art of engineering, which includes strong elements of intuition, imagination, and judgment. Engineering graduate students may participate in seminars appropriate to their fields of study.

A *minimum* of 30 units of earned graduate credit beyond the bachelor's degree is required for the M.S. degree: 12 in the major, 6 in related minor work (usually mathematics or natural science), 6 in either the major or minor subject or in other areas approved by the major department, and 6 for a research-based thesis. A nonthesis option requiring 30 units of course credit is available. Each of the departments imposes additional requirements in the exercise of this option. There is no language requirement for this degree.

A *minimum* of 60 units of earned graduate credit beyond the bachelor's degree is required for the Ph.D. degree. In civil and electrical engineering, 24 units are required in the major field and 12 units in a related minor field (often mathematics or natural science), 12 in either the major or minor subject or other areas approved by the major department and 12 for a research-based dissertation. In biomedical and mechanical engineering there are no specific course requirements; each program is planned to meet individual needs. Doctoral students are required to pass qualifying and preliminary examinations which may be either written, oral, or a combination of written and oral components, at the discretion of the committee and the department.

BIOMEDICAL ENGINEERING

Professors

Howard G. Clark, Ph.D.(Maryland); J. Dvorak, Ph.D.(Brown); David Geselowitz, Ph.D.(Pennsylvania); Robert M. Hochmuth, Ph.D.(Brown); James M. McElhaney, Ph.D.(West Virginia); Loren Nolte, Ph.D.(Michigan); Theo C. Pilkington, Ph.D.(Duke); *Chairman*; Frederick L. Thurstone, Ph.D.(North Carolina State); *Director of Graduate Studies*; Myron Wolbarsht, Ph.D.(Johns Hopkins).

Associate Professors

Roger Barr, Ph.D.(Duke); Donald S. Burdick, Ph.D.(Princeton); Evan A. Evans, Ph.D.(California at San Diego); William E. Hammond, Ph.D.(Duke); Howard C. Wachtel, Ph.D.(New York Univ.).

Assistant Professor

Olaf T. von Ramm, Ph.D.(Duke).

Biomedical engineering is often defined as the application of the concepts and methods of the physical, mathematical, and engineering sciences to biology and medicine. The definition covers a broad spectrum ranging from formalized mathematical theory through experimental science to practical clinical applications. The purpose of the graduate program in biomedical engineering is to encourage the optimum combining of engineering and biomedical course work with an interdisciplinary research topic so that the graduates of this program can contribute at the most advanced professional level to the interdisciplinary field of biomedical engineering. The major research areas available include: biomechanics, biomedical materials; biomedical modeling; data acquisition and processing; and electrophysiology.

Courses of Instruction

201. Analysis of Bioelectric Phenomena; 202. Energy and Rate in Biological Processes; 204. Real Time Measurement and Control of Heart Events; 207. Experimental Mechanics; 221. Electrophysiological Techniques; 223. Biomedical Materials and Artificial Organs; 225. Mechanics of Cellular Components; 230. Biomechanics; 233. Discrete Systems and Models of Computation; 241, 242. Information Organization and Retrieval; 243. Computers in Biomedical Engineering; 252. Marine Electrobiological; 265. Advanced Topics in Biomedical Engineering; 311. Inverse Models; 333. Biomedical Imaging; 399. Special Readings in Biomedical Engineering.

CIVIL ENGINEERING

Professors

Earl I. Brown, Ph.D.(Texas); *J. A. Jones Professor of Civil Engineering*; J. Dvorak, Ph.D.(Brown), *Director of Graduate Studies*; Robert J. Melosh, Ph.D.(Washington), *Chairman*; Bruce J. Muga, Ph.D.(Illinois); Senol Utku, Sc.D.(Massachusetts Inst. of Tech.); Aleksandar Sedmak Vesic, D.Sc.(Belgrade), *J. A. Jones Professor of Civil Engineering, Dean*; James F. Wilson, Ph.D.(Ohio State).

Associate Professors

Aubrey E. Palmer, B.S.C.E.(Virginia); P. Aarne Vesilind, (North Carolina at Chapel Hill).

Assistant Professors

Miguel A. Medina, Jr., M.S.(Alabama); Yuet Tsui, Ph.D.(Duke).

Adjunct Professor

Edward A. Saibel, Ph.D.(Massachusetts Inst. of Tech.).

Lecturers

Donald E. Francisco, Ph.D.(North Carolina at Chapel Hill); George T. Lathrop, M.C.P.(Yale).

A student may specialize in one of the following fields of study for either the M.S. or the Ph.D. degree: environmental engineering; geotechnical engineering and soil mechanics; mechanics of solids; materials engineering; fluid mechanics, water resources, and ocean engineering; structural engineering; and urban systems and transportation. Interdisciplinary programs combining study in some of the major areas with biological sciences, business administration, materials science, social sciences, political science, and other areas of engineering are also available. In addition, there is a special program leading to the M.S. degree in civil engineering and the A.M. degree in public policy sciences.

With the approval of the department, a master's degree candidate in civil engineering may choose, in lieu of submitting a thesis, to complete an additional 6 units of course work plus a special project. If this alternative is elected, candidates are expected to take comprehensive examinations over their graduate course work, and also to defend orally their special projects.

Under the Reciprocal Agreement with Neighboring Universities, a student may include as a portion of the minimum requirements work offered by the Department of Environmental Sciences and Engineering of the University of North Carolina. Although related work normally is taken in the natural sciences or mathematics, a student whose major interest relates to the social or managerial sciences may take relevant work in these areas.

A minimum prerequisite to the graduate program in civil engineering is a basic knowledge of mathematics through linear differential equations, materials science, solid mechanics, and fluid mechanics.

Courses of Instruction

201. Advanced Mechanics of Solids; 204. Plates and Shells; 205. Elasticity; 206. Advanced Mechanics of Solids II; 209. Structural Dynamics; 210. Intermediate Dynamics; 212. Mechanical Behavior of Materials; 215. Urban and Regional Geography; 216. Transportation Planning and Policy Analysis; 217. Transportation Systems Analysis; 218. Engineering-Economic Analysis; 221. Incompressible Fluid Flow; 222. Open Channel Flow; 223. Flow Through Porous Media; 224. Coastal and Offshore Engineering; 225. Engineering Hydrology; 231. Structural Engineering Analysis; 232. Reinforced Concrete Design; 233. Prestressed Concrete Design; 234. Structural Design in Metals; 235. Foundation Engineering; 236. Earth Structures; 238. Rock Mechanics; 241. Environmental Engineering Chemistry and Biology; 243. Sanitary Engineering Unit Operations and Process Design; 245. Pollutant Transport Systems; 246. Sanitary Engineering Design; 247. Air Pollution Control; 248. Solid Waste and Resource Recovery Engineering; 249. Resource Recovery Systems Management; 250. Engineering Analysis; 251. Systematic Structural Analysis I; 252. Systematic Structural Analysis II; 265. Advanced Topics in Civil Engineering; 306. Plasticity; 331. Special Problems of Systematic Analysis; 335. Mechanical Behavior of Soils; 336. Advanced Soil Mechanics; 337. Elements of Soil Dynamics; 350. Advanced Engineering Analysis; 399. Special Readings in Civil Engineering.

ELECTRICAL ENGINEERING

Professors

John Leslie Artley, D.Eng.(Johns Hopkins); Robert Blackburn Kerr, Ph.D.(Johns Hopkins); Peter N. Marinos, Ph.D.(North Carolina State), *Director of Graduate Studies*; Loren W. Nolte, Ph.D.(Michigan); Harry Ashton Owen, Jr., Ph.D.(North Carolina State); Theo C. Pilkington, Ph.D.(Duke); Paul P. Wang, Ph.D.(Ohio State); Thomas George Wilson, Sc.D.(Harvard).

Associate Professors

Herbert Hacker, Ph.D.(Michigan), *Chairman*; William Thomas Joines, Ph.D.(Duke).

Assistant Professor

Rhett Truesdale George, Jr., Ph.D.(Florida).

A student may specialize in any one of the following fields in working toward either the M.S. or the Ph.D. degree with a major in electrical engineering: solid state materials and devices; ferromagnetics; optical electronics and lasers; instrumentation; electronic systems; microwaves; control theory; energy conversion; digital systems; stochastic systems; and information processing.

Recommended prerequisites for the graduate courses in electrical engineering include a knowledge of basic mathematics and physics, electric networks, and systems theory. Students in doubt about their background for enrollment in specific courses should discuss the matter with the Director of Graduate Studies. The M.S. degree program includes either a thesis or an oral comprehensive examination. A qualifying examination is required for the Ph.D. degree program. These examinations are intended to test both the breadth and depth of the student's understanding of electrical engineering. There is no foreign language requirement.

Courses of Instruction

202. Modeling and Simulation; 203. Random Signals and Noise; 204. Information Theory and Communication Systems; 205. Signal Detection and Extraction Theory; 206. Digital Signal Processing; 207. Fault-Tolerant Computer Systems; 208. Digital Computer Design; 211. Solid State Theory; 212. Solid State Materials; 213. Principles of Magnetism; 215. Semiconductor Physics; 217. Lasers; 222. Nonlinear Analysis; 224. Integrated Electronics; 225. Semiconductor Electronic Circuits; 226. Modeling and Computer-Aided Analysis of Electronic Systems; 227. Network Synthesis; 231. Energy Systems; 234. Power Electronics: High-Power Circuits; 235. Nonlinear Magnetic and Semiconductor Power Converters: Design and Control I; 236. Nonlinear Magnetic and Semiconductor Power Converters: Design and Control II; 237, 238. Advanced Power Electronics Laboratory and Seminar; 241. Linear Systems; 242. Modern Control and Dynamic Systems; 243. Advanced Linear Systems Theory; 251. Pattern Classification and Recognition; 252. Computer Systems Organization; 265. Advanced Topics in Electrical Engineering; 266. Biofeedback Systems; 271. Electromagnetic Theory; 272. Application of Electromagnetic Theory; 297-298. Thesis Research; 304. Estimation, Filtering, and Random Systems; 305. Advanced Applications of Statistical Decision Theory; 306. Adaptive Detection and Communication Systems; 308. Advanced Topics in Digital Systems; 313. Magnetic Processes in Materials; 317. Quantum Electronics; 324. Nonlinear Oscillations in Physical Systems; 342. Optimal Control Theory; 371. Advanced Electromagnetic Theory; 373. Selected Topics in Field Theory; 399. Special Readings in Electrical Engineering.

MECHANICAL ENGINEERING AND MATERIALS SCIENCE

Professors

Jack Bartley Chaddock, Sc.D.(Massachusetts Inst. of Tech.), *Chairman*; Howard G. Clark, Ph.D.(Maryland); Franklin H. Cocks, Sc.D.(Massachusetts Inst. of Tech.), *Director of Graduate Studies*; Devendra P. Garg, Ph.D.(New York Univ.);

Charles Morgan Harman, Ph.D.(Wisconsin); George Wilbur Pearsall, Sc.D.(Massachusetts Inst. of Tech.).

Adjunct Professor

Verne L. Roberts, Ph.D.(Illinois).

Associate Professors

Ernest Elsevier, M.S.M.E.(Georgia Inst. of Tech.); Marion LaVerne Shepard, Ph.D.(Iowa State); Donald Wright, Ph.D.(Purdue).

Adjunct Associate Professor

George Mayer, Ph.D.(Massachusetts Inst. of Tech.).

Assistant Professors

Gale Herbert Buzzard, Ph.D.(North Carolina State); Timothy K. Hight, Ph.D.(Stanford); Charles E. Johnson, Ph.D.(Duke); Phillip L. Jones, Ph.D.(U.C.L.A.); Edward Shaughnessy, Jr., Ph.D.(Virginia).

Adjunct Assistant Professor

Ish Sud, Ph.D.(Duke).

Graduate study is available to students seeking the M.S. and Ph.D. degrees with a major in either mechanical engineering or materials science. Departmental programs of advanced study and research include photovoltaics, control systems, dynamics and vibrations, energy conversion, fluid mechanics, heat and mass transport, mechanical design, thermodynamics, physical metallurgy, corrosion, fracture, and polymer science. The faculty cooperates with faculty members from a number of other departments and schools to establish interdisciplinary research projects and programs of study in areas which include applied mechanics, biomechanics, biomedical materials, environmental quality and control, ocean engineering, systems engineering, engineering and public policy, and transportation systems.

The program includes the opportunity for experimental work as well as theoretical study. A major emphasis is placed upon developing the research ability of the student and relating the program to the evolving needs of modern engineering practice.

Courses of Instruction

202. Engineering Thermodynamics; 209. Structural Dynamics; 210. Intermediate Dynamics; 211. Theoretical and Applied Polymer Science; 213. Advanced Materials Science; 214. Corrosion and Corrosion Control; 216. Materials Design and Resource Conservation; 221. Compressible Fluid Flow; 222. Heat Transfer; 223. Principles and Design of Heat Transfer Equipment; 224. An Introduction to Turbulence; 226. Intermediate Fluid Mechanics; 227. Advanced Fluid Mechanics; 230. Modern Control and Dynamic Systems; 231. Systems Response and Control; 232. Nonlinear Analysis; 235. Advanced Mechanical Vibrations; 236. Engineering Acoustics and Noise Control; 254. Solar Energy Thermal Processes; 265. Advanced Topics in Mechanical Engineering; 273. Ocean Engineering; 280. Nuclear Reactor Power Cycles; 300. Advanced Projects in Mechanical Engineering; 302. Advanced Thermodynamics; 311. Behavior of Crystalline Solids; 321. Gas Dynamics; 322. Mechanics of Viscous Fluids; 323. Convective Heat Transfer; 324. Conduction and Radiation Heat Transfer; 327. Homogeneous Turbulence; 328. Turbulent Shear Flow; 331. Nonlinear Control Systems; 333.

Seminar in Control Systems; 335. Analytical Methods in Vibrations; 372. Finite Element Techniques in Design; 399. Special Readings in Mechanical Engineering.

English

Professors

Carl Anderson, Ph.D.(Pennsylvania); Louis J. Budd, Ph.D.(Wisconsin), *Chairman*; Edwin H. Cady, Ph.D.(Wisconsin), *Andrew W. Mellon Professor in the Humanities*; Bernard I. Duffey, Ph.D.(Ohio State); Oliver W. Ferguson, Ph.D.(Illinois); Robert F. Gleckner, Ph.D.(Johns Hopkins); Holger O. V. Nygard, Ph.D.(California at Berkeley), *Director of Graduate Studies*; Dale B. J. Randall, Ph.D.(Pennsylvania); Edmund Reiss, Ph.D.(Harvard); Clyde de Loache Ryals, Ph.D.(Pennsylvania); Grover C. Smith, Ph.D.(Columbia); Arlin Turner, Ph.D.(Texas); George W. Williams, Ph.D.(Virginia); Kenny J. Williams, Ph.D.(Pennsylvania).

Associate Professors

Ronald Richard Butters, Ph.D.(Iowa); A. Leigh DeNeef, Ph.D.(Pennsylvania State); Gerald E. Gerber, Ph.D.(Northwestern); Wallace Jackson, Ph.D.(Pennsylvania); Buford Jones, Ph.D.(Harvard); Elgin Mellow, Ph.D.(London); Gerald Monsman, Ph.D.(Johns Hopkins); Victor H. Strandberg, Ph.D.(Brown).

The department offers graduate work leading to the A.M., M.A.T., and Ph.D. degrees. A statement of the requirements for the A.M. and Ph.D. degrees may be obtained from the Director of Graduate Studies. The department requires a reading knowledge of one foreign language for the A.M. degree; for the Ph.D. degree, two languages determined by the student's committee.

Courses of Instruction

207. Old English Grammar and Readings; 208. History of the English Language; 209. Present-Day English; 210. Old English Literary Tradition; 212. Middle English Literary Tradition; 215. Chaucer; 216. Chaucer; 221. English Prose and Poetry of the Sixteenth Century; 223. Spenser; 224. Shakespeare; 225, 226. Tudor and Stuart Drama, 1500-1642; 229, 230. English Literature of the Seventeenth Century; 232. Milton; 234. English Drama, 1642-1800; 235, 236. The Eighteenth Century; 241, 242. English Literature of the Early Nineteenth Century; 245, 246. English Literature of the Later Nineteenth Century; 251, 252. English Literature of the Twentieth Century; 263, 264. American Literature, 1800-1865; 267, 268. American Literature, 1865-1915; 270, 271. Southern Literature; 275, 276. American Literature since 1915; 280. Introduction to Folklore; 285. Literary Criticism; 287. Theory of Literature from Kant to the Present; 310. Beowulf; 312. Studies in Middle English Literature; 315. Studies in Chaucer; 318. Medieval Romances; 320. Studies in Renaissance English Prose; 324. Studies in Shakespeare; 325. Studies in the English Drama of the Sixteenth and Seventeenth Centuries; 329. Studies in the Metaphysical Poets; 330. Studies in Dryden and His Age; 337. Studies in English Augustanism; 338. Studies in the Age of Johnson; 339. The Eighteenth-Century Novel; 341. Studies in English Romanticism; 347. Studies in Victorian Poetry; 348. Studies in Victorian Fiction; 353. Studies in British Poetry of the Twentieth Century; 354. Studies in British Prose of the Twentieth Century; 361. Studies in a Major American Author of the Early Nineteenth Century; 362. Studies in a Major American Author of the Later Nineteenth Century; 364. Hawthorne and Melville; 368. Studies in American Realistic Fiction; 369. Studies in American Humor; 375. Studies in American Poetry of the Twentieth Century; 376. Studies in American Prose of the Twentieth Century; 380. The Traditional Ballad and Folksong; 383. Textual

Criticism; 387. Special Topics Seminar; 390. Seminar in the Teaching of Composition.

Forestry and Environmental Studies

Professors

Roger Fabian Anderson, Ph.D.(Minnesota); Robert Lloyd Barnes, Ph.D.(Duke), *Director of Graduate Studies*; Henry Hellmers, Ph.D.(California at Berkeley); Benjamin A. Jayne, Ph.D.(Yale), *Dean*; Frederick C. Joerg, M.B.A.(Harvard); Kenneth Richard Knoerr, Ph.D.(Yale); Jane Philpott, Ph.D.(Iowa); Charles William Ralston, Ph.D.(Duke); Gerald R. Stairs, Ph.D.(Yale); William James Stambaugh, Ph.D.(Yale).

Adjunct Professor

William J. Hart, M.P.A.(Harvard).

Associate Professors

Frank J. Convery, Ph.D.(State Univ. of New York); Curtis J. Richardson, Ph.D.(Tennessee); P. Aarne Vesilind, Ph.D.(North Carolina at Chapel Hill); David O. Yandle, Ph.D.(North Carolina State).

Adjunct Associate Professors

George F. Dutrow, Ph.D.(Duke); Louis John Metz, Ph.D.(Duke).

Assistant Professors

R. Rajagopal, Ph.D.(Michigan); William Andrew Thompson, Ph.D.(Univ. of British Columbia).

Adjunct Assistant Professor

J. Michael Vasievich, Ph.D.(Duke).

Instructor and Research Associate

Jack P. Royer, M.S.(American).

Major and minor work is offered in the areas of natural resource science, management, and policy; leading to the Master of Arts, Master of Science, and Doctor of Philosophy degrees. College graduates who have a bachelor's degree in one of the natural or social sciences, forestry, engineering, business, or environmental science will be considered for admission to a degree program. Students will be restricted to the particular fields of specialization for which they are qualified academically. Graduate School programs usually concentrate on some area of natural resource science or policy, while study in resource management is more commonly followed in one of the professional master's degree programs of the School of Forestry and Environmental Studies. For information on professional training in forestry or environmental studies, the *Bulletin of the School of Forestry and Environmental Studies* should be consulted.

The specific degrees available in forestry and related natural resources through the Graduate School are: the A.M. (with or without a thesis), M.S. (with a thesis), and the Ph.D. Students majoring in forestry or environmental studies may be required to demonstrate satisfactory knowledge of one or two foreign languages for the Ph.D. degree. More information on degree and language requirements can be found in the program information section of the bulletin.

Courses of Instruction

RESOURCE SCIENCE

203. General Meteorology; 204. Microclimatology; 206. Anatomy of Woody Plants; 209. Tree Biology; 211. Resource Ecology and Ecosystem Analysis; 212. Population Ecology; 216. Watershed Hydrology; 217. Environmental Instrumentation; 218. Barrier Island Ecology; 222. Biology of Forest Insects and Diseases; 223. Forest Pathology; 225. Chemical Aspects of Forest Protection; 230. Forest Entomology; 264. Soil Classification and Interpretation; 292. Microtechnique of Soft Woody Plant Tissues; 305. Forest Biochemistry; 321. Phytopathological Technique in Forestry; 322. Microbiology of Forest Soils; 332. Ecology of Forest Insects; 342. Hydrologic Processes; 350. Vegetation Productivity and Mineral Cycling in the Ecosystem; 366. Soil Fertility and Forest Production.

MEASUREMENTS, STATISTICS, AND MODELING

250. Biometry; 251. Theory and Methods for Sampling Biological Populations; 252. Natural Resource Data Analysis; 253. Information Processing for Resource Management; 258. Quantitative Analysis in Resource Management; 354. Biological and Resource System Simulation.

NATURAL RESOURCE MANAGEMENT

282. Natural Resource Management; 349. Wildland and Wildlife Management.

NATURAL RESOURCE POLICY

269. Resource Economics and Policy; 270. Economics of Forestry; 273. Economics and Environmental Quality.

SEMINARS

277. Seminar in Natural Resource Allocation and Efficiency; 344. Micrometeorology and Biometeorology Seminar; 346. Seminar in Resource and Environmental Policy; 347. Seminar in Natural Resource Ecology; 348. Integrated Case Studies in Natural Resource Analysis Seminar; 385. Seminar in Forest Protection; 386. Seminar in Forest Management.

SPECIAL STUDIES AND PROJECTS

201. Field Studies; 202. Student Projects; 299. Independent Projects.

The University Program in Genetics

Professors

D. Bernard Amos, M.D.(Guys Hospital, London); Janis Antonovics, Ph.D.(Univ. Coll. of North Wales); John E. Boynton, Ph.D.(California at Davis); Richard O. Burns, Ph.D.(Illinois); Sheila J. Counce, Ph.D.(Edinburgh); Nicholas Gillham, Ph.D.(Harvard); Samson R. Gross, Ph.D.(Columbia); Walter R. Guild, Ph.D.(Yale), *Director*; Calvin L. Ward, Ph.D.(Texas); Robert E. Webster, Ph.D.(Duke).

Associate Professors

Ronald C. Greene, Ph.D.(California Inst. of Tech.); Frances E. Ward, Ph.D.(Brown).

Assistant Professors

Sharyn Endow, Ph.D.(Yale); Arno L. Greenleaf, Ph.D.(Harvard); Mary Vickers Hershfield, Ph.D.(Georgetown); Michael Steven Hershfield, M.D.(Pennsylvania); Edward W. Holmes, M.D.(Pennsylvania); Nicholas Kredich, M.D.(Michigan); Paul L. Modrich, Ph.D.(Stanford); Frederick H. Schachat, Ph.D.(Stanford); Deborah A. Steege, Ph.D.(Yale).

The University Program in Genetics provides a coherent course of study in all facets of biology related to genetics. Graduate students registered in any of the biological sciences departments may apply to the faculty of the genetics program to pursue study and research leading to an advanced degree. It would be helpful if applicants for admission to the Graduate School indicated their interest in the genetics program at the time of application. Requests for information describing more completely the research interests of the staff, facilities, and special stipends and fellowships should be addressed to the Director, Genetics Program (151 Nanaline H. Duke).

Courses of Instruction

216. Molecular Genetics; 280. Principles of Genetics; 282. Experimental Genetics; 283. Extrachromosomal Inheritance; 284. Current Topics in Genetic Mechanisms; 285. Ecological Genetics; 286. Evolutionary Mechanisms; 287S. Quantitative Genetics; 288S. The Cell in Development and Heredity; 289. Problems in Genetics in Current Research; 336. Immunogenetics; 351-352. Genetics Seminar.

Geology

Professors

S. Duncan Heron, Jr., Ph.D.(North Carolina at Chapel Hill), *Director of Graduate Studies*; Ronald D. Perkins, Ph.D.(Indiana), *Chairman*; Orrin H. Pilkey, Ph.D.(Florida State).

Associate Professors

William J. Furbish, M.S.(Wisconsin); George W. Lynts, Ph.D.(Wisconsin).

Assistant Professor

Bruce R. Rosendahl, Ph.D.(California at San Diego).

The Department of Geology offers graduate work leading to the M.S. and Ph.D. degrees. An undergraduate degree in geology is not a prerequisite for graduate studies, but a student must have had or must take a summer field geology course (or equivalent experience), mineralogy, petrology, stratigraphy, paleontology, and structural geology. In addition, the student must have had one year of college chemistry, one year of college physics, and mathematics through calculus.

Graduate courses in the Department of Geology are designed to provide specialized training in the fields of geological oceanography, sedimentology, stratigraphy, paleontology, geophysics, and low-temperature mineralogy.

An acceptable thesis is required. There is no language requirement for the M.S. degree.

The Ph.D. degree is available through the Earth Science Consortium, a new interuniversity doctoral program combining the faculties and research facilities of Duke, Emory, Tulane, and Vanderbilt Universities. The Earth Science Consortium offers specialization in the areas of paleontology, sedimentology, stratigraphy, marine geology and geophysics, environmental geology, and regional geology.

Under this program, a student admitted to Duke University would be expected to spend one year of study at another of the participating universities. Such a program offers the student a broadly-based faculty with diverse research interests and the opportunity to pursue graduate education in a variety of geologic settings. Normally, a candidate would hold the master's degree at the time of admission to the program. Additional information concerning the details of the doctoral program is available upon request.

Courses of Instruction

205. Geological Oceanography; 206S. Principles of Geological Oceanography; 211S. Stratigraphic Principles and Application; 212. Carbonate Facies Analysis: Recent and Ancient; 213. Sedimentology; 214S. Sedimentary Petrography; 215. Clastics Facies Analysis: Recent and Ancient; 229. Economic Geology; 230. Principles of Structural Geology; 234S. Geochemistry; 235S. Global Tectonics; 241. Invertebrate Paleobiology I; 242. Invertebrate Paleobiology II; 243-244. Micropaleontology; 247. Paleoecology; 250. Introduction to Marine Geophysics; 251. Principles of Geophysics; 252. Marine Geophysics; 253S. Seminar in Geophysics; 260S. Hydrocarbon Exploration; 300. Seminar in Oceanography; 310. Seminar in Stratigraphy; 312. Seminar in Sedimentology; 320. Seminar in Mineralogy; 330. Seminar in Geochemistry; 340. Seminar in Paleontology; 350. Seminar in Geomathematics; 360. Seminar in Geophysics; 371, 372. Advanced Topics in Geology.

Germanic Languages and Literature

Professor

Leland R. Phelps, Ph.D.(Ohio State), *Chairman*.

Visiting Professor

Harold Jantz, Ph.D.(Wisconsin).

Associate Professors

A. Tilo Alt, Ph.D.(Texas); Frank Borchardt, Ph.D.(Johns Hopkins); James L. Rolleston, Ph.D.(Yale), *Director of Graduate Studies*.

Assistant Professor

Donald K. Rosenberg, Ph.D.(Ohio State).

The Department of Germanic Languages and Literature offers graduate work leading to the A.M. degree. Students who expect to major in German should have had sufficient undergraduate courses in Germanic languages to enable them to proceed to more advanced work.

Students who wish to take courses in German as a related field should normally have completed a third-year course (in exceptional cases, a second year) of college German with acceptable grades.

Courses of Instruction

200. Proseminar; 201S, 202S. Goethe; 203S. Eighteenth Century; 205, 206. Middle High German; 207S. German Romanticism; 209S. Drama; 211S. Nineteenth-Century Literature; 214S. The Twentieth Century; 215S. Seventeenth-Century Literature; 216. History of the German Language; 217S. Renaissance and Reformation Literature; 218S. The Teaching of German; 219. Applied Linguistics; 230. Lyric Poetry; 301. Gothic; 321, 322. Germanic Seminar.

Health Administration

Professors

Montague Brown, D.P.H.(North Carolina at Chapel Hill); Jon Jaeger, Ph.D.(Duke), *Chairman*; David G. Warren, J.D.(Duke).

Adjunct Professor

Arnold D. Kaluzny, Ph.D.(Michigan).

Associate Professors

Barbara McCool, Ph.D.(Ohio State); Wilma A. Minniear, M.S.N.(Case Western Reserve); Louis E. Swanson, A.B.(Hamilton).

Adjunct Associate Professors

Elizabeth J. Coulter, Ph.D.(Radcliffe); Richard H. Peck, M.H.A.(Duke).

Assistant Professors

Thomas J. Delaney, M.S.(U.S. Naval Postgraduate School); David J. Falcone, Ph.D.(Duke); Donald S. Smith II, M.H.A.(Minnesota), *Director of Graduate Studies*; David Michael Warner, Ph.D.(Tulane).

Lecturer

Robert G. Winfree, M.A.(Iowa).

Graduate study leading toward preparation for a career in the administration of all types of health organizations and programs is offered through a twenty-month academic program that leads to the M.H.A. degree. Students without previous administrative experience in the health field are urged to undertake a twelve-month administrative residency following graduation. This residency is a period of varied administrative experience that is conducted under faculty supervision and is individually designed around each student's interests. For students without previous administrative experience, the residency should be considered an integral part of the M.H.A. program. Admission to this program is based upon suitability of the candidate to assume leadership roles in the organization and management of the delivery of health services, as well as on capability for graduate study.

Courses of Instruction

300. Introduction to Medical Care; 301. The Health System and Its Environment; 312. Comparative Health Systems; 313. Quantitative Decision Making; 320. Principles of Economics; 326. Health Economics; 331, 332. Planning Health Services; 333. Health Finance; 335. Ambulatory Health Services; 340. Social Dimensions of Illness; 343. Human Resource Development in Health Institutions; 344. Human Resource Management in Health Institutions; 345. Public Policy and Health Care; 346. Community Health Services; 348. Legal Considerations in Health Administration; 351. Institutional Health Services; 352. Ambulatory Health Services; 353. Community Health Services; 360. Seminar in Health Administration; 361, 362. Case Studies in Health Administration; 363. Health Administration Game; 371, 372. Directed Research; 373. Current Legal Problems in Health Administration; 377. Research Design and Data Analysis; 381. Strategy and Organizational Design for Health Systems; 387. Information Systems.

Management Sciences Courses for Students in Health Administration

300. Managerial Economics; 310. Quantitative Methods; 311. Statistical Analysis for Management Decisions; 320. Organization Analysis and Design; 330. Financial Accounting; 331. Managerial Accounting; 333. Controllership; 344. Human Resources Management; 351. Financial Management.

History

Professors

Joel G. Colton, Ph.D.(Columbia); Calvin D. Davis, Ph.D.(Indiana); Robert F. Durden, Ph.D.(Princeton), *Chairman*; Arthur B. Ferguson, Ph.D.(Cornell); Gerald Hartwig, Ph.D.(Indiana); Irving B. Holley, Jr., Ph.D.(Yale); Frederic Hollyday, Ph.D.(Duke); Warren Lerner, Ph.D.(Columbia); John F. Oates, Ph.D.(Yale); Richard A. Preston, Ph.D.(Yale), *William K. Boyd Professor of History*; Theodore Ropp, Ph.D.(Harvard); Anne Firor Scott, Ph.D.(Radcliffe); William E. Scott, Ph.D.(Yale); John J. TePaske, Ph.D.(Duke); Richard L. Watson, Ph.D.(Yale); Charles Young, Ph.D.(Cornell).

Associate Professors

Charles W. Bergquist, Ph.D.(Stanford); John Cell, Ph.D.(Duke); William Chafe, Ph.D.(Columbia); John Crellin, Ph.D.(Univ. of London); Peter R. Decker, Ph.D.(Columbia); Arif Dirlik, Ph.D.(Rochester); Raymond Gavins, Ph.D.(Virginia); James F. Gifford, Ph.D.(Duke); Lawrence C. Goodwyn, Ph.D.(Texas); Charles S. Maier, Ph.D.(Harvard); Seymour Mauskopf, Ph.D.(Princeton); Martin Miller, Ph.D.(Chicago); Sydney Nathans, Ph.D.(Johns Hopkins); John F. Richards, Ph.D.(California at Berkeley), *Director of Graduate Studies*; Ronald Witt, Ph.D.(Harvard); Peter H. Wood, Ph.D.(Harvard).

Assistant Professors

Joseph di Corcia, Ph.D.(Duke); Thomas M. Huber, Ph.D.(Chicago); Bruce R. Kuniholm, Ph.D.(Duke).

Visiting Assistant Professor

William M. Reddy, Ph.D.(Chicago).

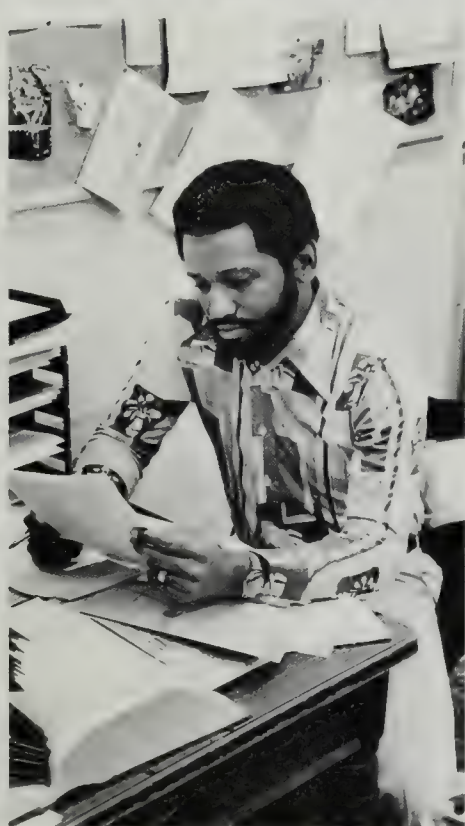
The Department of History offers graduate work leading to the A.M. and Ph.D. degrees. Candidates for the A.M. degree must have a reading knowledge of at least one ancient or modern foreign language related to their programs of study and have completed successfully a substantial research paper, normally the product of a year's seminar or two semester-courses. The paper must be approved by two readers—the supervising professor and a second professor from the graduate staff. Students anticipating a May degree must have their papers read and approved by April 15; those anticipating a September degree must have their papers read and approved by August 15.

Candidates for the degree of Doctor of Philosophy are required to prepare themselves for examinations in four fields. Three usually shall be history. The choice of fields is determined in consultation with the student's supervisor and the Director of Graduate Studies. The department offers graduate instruction in the fields of Africa, Afro-American history, ancient history, medieval and early modern Europe, modern Europe, American history, Britain and the Commonwealth, Imperial Russia, Soviet Russia, Latin America, South Asia, modern China, modern Japan, military history, history of science, and history of medicine. The candidate for the Ph.D. degree usually must have a reading knowledge of two

foreign languages, but in certain cases where the candidate's supervisor and the Director of Graduate Studies approve, and where the candidate's research for the dissertation would appreciably benefit, an alternative to the second language may be accepted. This alternative usually would take the form of successfully completed formal training in an auxiliary discipline (such as statistics or a course in one of the other social sciences with an emphasis upon methodology) of 3 to 6 units, or the equivalent, depending on the student's program. It also must be in addition to any previous undergraduate work in the discipline. The requirement, whether satisfied by two languages or by one language and an alternative, must be met prior to the preliminary examination.

Courses of Instruction

201S, 202S. Aspects of Change in Prerevolutionary Russia; 203. The Uses of History in Public Policy: I; 204. The Uses of History in Public Policy: II; 205S. Progressive Era in the United States and World War I; 206S. The Nineteen-Twenties and the New Deal in the United States; 207S, 208S. The Development of Urban America; 209S, 210S. Topics in Afro-American History, 1619-Present; 212. Recent Interpretations of United States History; 213. Medicine and Society in America; 215-216. The Diplomatic History of the United States; 217S. Fascism and Its Background; 218S. Twentieth-Century Europe: Social and Economic Issues; 219. Culture and Society in German Speaking Europe, 1870-1930; 221. Problems in the Economic and Social History of Europe, 1200-1700; 222. Problems in European Intellectual History, 1250-1550; 223S, 224S. The Old Regime, the Enlightenment, and the French Revolution; 227-228. Recent United States History: Major Political and Social Movements; 229. Recent Interpretations of Modern European History; 230. Recent Interpretations of Asian History; 231S, 232S. Problems in the History of Spain and the Spanish Empire; 234S. Political Economy of Development: Theories of Change in the Third World; 237S. Europe in the Early Middle Ages; 238S. Europe in the High Middle Ages; 240. Aspects of Traditional and Modern African Culture; 241-242. Modernization and Revolution in China; 243-244. Marxism and History; 247. History of Modern India and Pakistan, 1707-1857; 248. History of Modern India and Pakistan, 1857 to the Present; 249-250. Social and Intellectual History of the United States; 253S, 254S. Europe Between the Wars; 255S-256S. Problems in African History; 260. Economic History of Japan; 261-262. Problems in Soviet History; 263-264. American Colonial History and the Revolution 1607-1789; 265S, 266S. Problems in Modern Latin American History; 267S-268S. From Medieval to Early Modern England; 269-270. British History, Seventeenth Century to the Present; 272. Poverty in the United States: An Historical Perspective; 273, 274. Topics in the History of Science; 275S, 276S. Central Europe, 1848-1918; 277S. The Coming of the Civil War in the United States, 1820-1861; 278S. The Civil War in the United States and its Aftermath, 1861-1900; 280. Historiography; 282S. Seminar on Canada; 283. Political and Social Change in the United States, 1789-1860; 285S, 286S. Oral History; 287-288. History of Modern Japan; 297S. The British Empire of the Nineteenth Century; 298S. The Commonwealth in the Twentieth Century; 307-308. Seminar in United States History; 317, 318. Seminar in the History of Western Europe; 371-372. Research Seminars; 401. Seminar on the British Commonwealth; 351-352. Colloquia; 312. Seminar in the Teaching of History in College; 314. Historical and Social Science Methodology; 399. Independent Study.



Marine Sciences—The University Program

Professors

Cazlyn Green Bookhout, Ph.D.(Duke), *Emeritus*; John Costlow, Ph.D.(Duke), *Director*; Orrin Pilkey, Ph.D.(Florida State).

Associate Professors

Richard T. Barber, Ph.D.(Stanford); Richard B. Forward, Ph.D.(California at Santa Barbara); John Gutknecht, Ph.D.(North Carolina at Chapel Hill); David R. McClay, Ph.D.(North Carolina at Chapel Hill); Richard B. Searles, Ph.D.(California at Berkeley); J. Bolling Sullivan, Ph.D.(Texas); John Sutherland, Ph.D.(California at Berkeley).

Adjunct Associate Professor

J. Douglas Glaeser, Ph.D.(Northwestern).

Assistant Professors

Norman L. Christensen, Jr., Ph.D.(California at Santa Barbara); Joseph S. Ramus, Ph.D.(California at Berkeley); Bruce R. Rosendahl, Ph.D.(California at San Diego).

Training in the marine sciences at Duke University includes marine biology, marine geology, and oceanography. The departments which are chiefly concerned are botany, chemistry, geology, and zoology.

Graduate students working in the marine sciences will take their degrees under the auspices of one of the above departments and must, therefore, meet the requirements of that department. During the first part of the training the student will usually take courses on the Durham campus during the academic year and enroll in more specialized courses in the marine sciences at the Duke University Marine Laboratory during the summer. After the completion of the course work and preliminary examination (for doctoral candidates) the candidate may, with approval of the major professor, request space for thesis research at the Marine Laboratory.

Persons interested in graduate work in marine sciences should apply through one of the appropriate departments. Forms may be obtained from the Graduate School.

Applications for summer courses at the Laboratory should be addressed to the Admissions Office, Duke University Marine Laboratory, Beaufort, North Carolina 28516. The form may be obtained from the *Bulletin of the Marine Laboratory*. The application for enrollment in the Duke University summer session should be accompanied by transcripts of undergraduate and graduate work. Applications should be received as early as possible.

Students registering for research should do so under the appropriate departmental numbers.

The following courses are offered during the summer at Beaufort. See the Marine Laboratory bulletin for the current schedule of courses.

SUMMER COURSES AT BEAUFORT

Courses of Instruction

203. Marine Ecology; 204L. Marine Microbiology; 205. Geological Oceanography; 211. Marine Phycology; 212. Membrane Physiology and Osmoregulation; 214. Biological Oceanography; 216. Photosynthetic Physiology of Marine Plants; 218. Barrier Island Ecology; 230. Environmental Oceanography; 240.

Chemical Oceanography; 244L. Diversity of Plants; 247L. Plant Ecology; 250L. Physiological Ecology of Marine Animals; 250. Introduction to Marine Geophysics; 274. Marine Invertebrate Zoology; 276. Comparative and Evolutionary Biochemistry; 278L. Invertebrate Embryology; 281L. Marine Invertebrate Larvae; 353, 354. Research; 359, 360. Research.

Mathematics

Professors

William K. Allard, Ph.D.(Brown); James Greig Arthur, Ph.D.(Yale); Francis Joseph Murray, Ph.D.(Columbia); Michael C. Reed, Ph.D.(Stanford), *Director of Graduate Studies*; David G. Schaeffer, Ph.D.(Massachusetts Inst. of Tech.); Joseph Robert Schoenfield, Ph.D.(Michigan); Seth L. Warner, Ph.D.(Harvard), *Chairman*; Morris Weisfeld, Ph.D.(Yale).

Associate Professors

Donald Stanley Burdick, Ph.D.(Princeton); Richard Earl Hodel, Ph.D.(Duke); Joseph W. Kitchen, Jr., Ph.D.(Harvard); David P. Kraines, Ph.D. (California at Berkeley); Lawrence Carlton Moore, Jr., Ph.D.(California Inst. of Tech.); Richard A. Scoville, Ph.D.(Yale); David A. Smith, Ph.D.(Yale).

Adjunct Associate Professor

Jagdish Chandra, Ph.D.(Rensselaer).

Assistant Professors

Detlef Hardorp, Ph.D.(Princeton); Daniel A. Flath, Ph.D.(Harvard); Robert J. V. Jackson, Ph.D.(Princeton); William Leslie Pardon, Ph.D.(Princeton); Bruce A. Reznick, Ph.D.(Stanford); Eric Schechter, Ph.D.(Chicago); Robert L. Wolpert, Ph.D.(Princeton).

Graduate work in the Department of Mathematics is offered leading to the M.S., A.M., and Ph.D. degrees. Admission to these programs is based on the applicant's undergraduate academic record, level of preparation for graduate study, the Graduate Record Examination, and letters of recommendation.

All A.M. and Ph.D. candidates are required to pass a comprehensive examination after completing their first year of graduate study. The A.M. degree with a major in mathematics is awarded upon completion of 30 units of graded course work and passing the comprehensive examination. A thesis may be substituted for 6 units of course work only under special circumstances. The department also offers a program in applied statistics with a minor in computer science leading to the M.S. degree.

Candidacy for the Ph.D. is established by passing the comprehensive examination at the Ph.D. level, completing the department's language requirements, and passing an oral preliminary examination. The preliminary examination is normally taken at the beginning of the third year. The preliminary examination is conducted by a committee selected by the rules of the Graduate School and the department. The examination can, at the student's option, consist of either questions based on the student's course work at Duke or on the specific area of research plus a minor subject selected by the student.

After admission to candidacy, the Ph.D. degree is awarded on the basis of the student's scholarly ability as demonstrated by the dissertation and its defense. The dissertation is the most important requirement in the award of the Ph.D. degree.

Mathematics courses 210, 211, 212, 213, and 214 are normally offered in the summer only. For information see the *Bulletin of Duke University Summer Session*.

Courses of Instruction

200. Introduction to Algebraic Structures I; 201. Introduction to Algebraic Structures II; 203. Basic Analysis I; 204. Basic Analysis II; 221, 222. Numerical Analysis I, II; 230. Mathematical Methods in Physics and Engineering I; 231. Mathematical Methods in Physics and Engineering II; 234. Mathematics for Quantum Mechanics; 235. Topics in Mathematical Physics; 238, 239. Topics in Applied Mathematics; 240. Applied Stochastic Processes; 241. Linear Models; 242. Multivariate Statistics; 248, 249. Topics in Statistics; 250. Introductory Mathematical Logic; 251. Set Theory I; 252. Set Theory II; 258, 259. Topics in Logic; 260. Groups, Rings, Modules; 261. Commutative Algebra; 268, 269. Topics in Algebra; 270. General Topology; 271. Algebraic Topology; 278-279. Topics in Topology; 280. Differential Analysis; 281. Real Analysis I; 282. Real Analysis II; 283. Linear Operators; 284. Topics in Functional Analysis; 285. Complex Analysis; 286. Topics in Complex Analysis; 288, 289. Topics in Analysis; 290. Probability; 291. Stochastic Processes; 293, 294. Topics in Probability Theory; 297. Fourier Analysis and Distribution Theory; 298. Partial Differential Equations I; 299. Partial Differential Equations II; 358-359. Current Research in Logic; 368-369. Current Research in Algebra; 378-379. Current Research in Topology; 387. Current Research in Mathematical Physics; 388-389. Current Research in Analysis.

Program in Medieval and Renaissance Studies

The graduate Program in Medieval and Renaissance Studies is administered by the Duke University Committee on Medieval and Renaissance Studies.

DEPARTMENT OF ART

233. Early Medieval Architecture.

DEPARTMENT OF CLASSICAL STUDIES

Latin

221. Medieval Latin I; 222. Medieval Latin II; 225. Paleography; 305. Latin Seminar V; 306. Latin Seminar VI; 312. Proseminar in Latin Paleography.

Classical Studies

327. Seminar in Byzantine History.

DEPARTMENT OF ENGLISH

207. Old English Grammar and Readings; 208. History of the English Language; 210. Old English Literary Tradition; 212. Middle English Literary Tradition; 215, 216. Chaucer; 221. English Prose and Poetry of the Sixteenth Century; 223. Spenser; 224. Shakespeare; 225, 226. Tudor and Stuart Drama, 1500-1642; 229. English Literature of the Seventeenth Century; 232. Milton; 310. Beowulf; 312. Studies in Middle English Literature; 315. Studies in Chaucer; 318. Medieval Romances; 320. Studies in Renaissance English Prose; 324. Studies in Shakespeare; 325. Studies in the English Drama of the Sixteenth and Seventeenth Centuries; 329. Studies in the Metaphysical Poets; 383. Textual Criticism.

DEPARTMENT OF GERMANIC LANGUAGES AND LITERATURE

205, 206. Middle High German; 215S. Seventeenth Century Literature; 216. History of the German Language; 217S. Renaissance and Reformation Literature.

DEPARTMENT OF HISTORY

221. Problems in the Economic and Social History of Europe, 1200-1700; 222. Problems in European Intellectual History, 1250-1550; 237S. Europe in the Early Middle Ages; 238S. Europe in the High Middle Ages; 267S-268S. From Medieval to Early Modern England.

DEPARTMENT OF PHILOSOPHY

218S. Medieval Philosophy.

DEPARTMENT OF RELIGION

206. Christian Mysticism in the Middle Ages; 219. Augustine; 236. Luther and the Reformation in Germany; 241. Problems in Reformation Theology; 251. The Counter-Reformation and the Development of Catholic Dogma; 334. Theology and Reform in the Later Middle Ages; 338. Calvin and the Reformed Tradition; 339. The Radical Reformation; 344. Zwingli and the Origins of Reformed Theology.

DEPARTMENT OF ROMANCE LANGUAGES

French

213. French Literature of the Seventeenth Century; 214. The "Moralistes" of the Seventeenth Century; 219. Old French Literature; 224. History of the French Language; 225. French Prose of the Sixteenth Century; 226. Topics in Renaissance Poetry; 311, 312. French Seminar. (Medieval and Renaissance Topics).

Italian

284. Dante; 285. Dante; 288. The Renaissance.

Spanish

251. The Origins of Spanish Prose Fiction; 252. Spanish Lyric Poetry before 1700; 253. The Origins of the Spanish Theater; 257. History of the Spanish Language; 258. Medieval Literature; 265. Cervantes; 266. Drama of the Golden Age; 321, 322. Hispanic Seminar (Medieval and Renaissance Topics).

Microbiology and Immunology

Professors

D. Bernard Amos, M.D.(Guys Hospital, London), *James B. Duke Professor of Immunology*; Richard O. Burns, Ph.D.(Illinois); Eugene D. Day, Ph.D.(Delaware); Wolfgang Karl Joklik, D.Phil.(Oxford), *James B. Duke Professor of Microbiology and Immunology and Chairman*; Richard S. Metzgar, Ph.D.(Buffalo); Suydam Osterhout, M.D.(Duke), Ph.D.(Rockefeller Inst.); Wendell Rosse, M.D.(Chicago); Robert W. Wheat, Ph.D. (Washington); Hilda Pope Willett, Ph.D.(Duke), *Director of Graduate Studies*.

Associate Professors

Dani P. Bolognesi, Ph.D.(Duke); Rebecca Buckley, Ph.D.(North Carolina at Chapel Hill); Peter Cresswell, Ph.D.(London); Jeffrey R. Dawson, Ph.D.(Case

Western Reserve); David J. Lang, M.D.(Harvard); Nelson Levy, M.D.(Columbia), Ph.D.(Duke); David W. Scott, Ph.D.(Yale); H. F. Seigler, M.D.(North Carolina at Chapel Hill); Ralph E. Smith, Ph.D.(Colorado); Ralph Snyderman, M.D.(State Univ. of New York, Downstate Med. Ctr.); Thomas C. Vananman, Ph.D.(Duke); Frances E. Ward, Ph.D.(Brown); Peter Zwadyk, Jr., Ph.D.(Iowa).

Assistant Professors

C. Edward Buckley III, M.D.(Duke); Jeffrey J. Collins, Ph.D.(Harvard); Sharyn Endow, Ph.D.(Yale); Linda R. Gooding, Ph.D.(Cornell); Hillel S. Koren, Ph.D.(Freiburg); Peter K. Lauf, M.D.(Freiburg); Jonathan P. Leis, Ph.D.(Cornell); David R. McClay, Ph.D.(North Carolina at Chapel Hill); Thomas G. Mitchell, Ph.D.(Tulane).

Assistant Medical Research Professors

John Clifford Cambier, Ph.D.(Iowa); Ronald B. Corley, Ph.D.(Duke); Mary Vickers Hershfield, Ph.D.(Georgetown); Nancy Role Mendell, Ph.D.(North Carolina at Chapel Hill); Sara Elizabeth Miller, Ph.D.(Georgia); W. David Sedwick, Ph.D.(Pennsylvania).

The department offers graduate work leading to the Ph.D. degree. Specialization is possible in molecular virology, viral oncology, cell biology, microbial physiology, immunochemistry, immunogenetics, cancer immunology, and general immunology.

Undergraduate preparation in biochemistry and physical chemistry is required. A brochure describing the Ph.D. degree program, prerequisites for admission, and research in the department can be obtained by writing the Director of Graduate Studies, Box 3020, Duke University Medical Center, Durham, N.C. 27710.

Courses of Instruction

214. Fundamentals of Electron Microscopy; 219. Molecular and Cellular Bases of Development; 219S. Seminar; 221. Medical Microbiology; 233. Principles of Microbiology and Immunology; 242. Mechanisms of Microbial Pathogenicity; 244. Principles of Immunology; 252. General Virology and Viral Oncology; 282. Molecular Microbiology; 291. Basic Immunology; 296. Immunochemistry; 323. Readings in Bacteriology and Immunology; 325. Medical Mycology; 330. Medical Immunology; 331.1-331.8. Microbiology Seminar; 332.1-332.8. Immunology Seminar; 336. Immunogenetics; 420. Cellular Immunophysiology.

Pathology

Professors

Darell D. Bigner, M.D., Ph.D.(Duke), *Director of Graduate Studies*; Bernard F. Fetter, M.D.(Duke); Donald B. Hackel, M.D.(Harvard); Robert E. Jennings, M.D.(Northwestern), *Chairman*; William W. Johnston, M.D.(Duke); Gordon K. Klintworth, M.B., Ph.D.(Witwatersrand); Philip Pratt, M.D.(Johns Hopkins); Joachim R. Sommer, M.D.(Munich); F. Stephen Vogel, M.D.(Western Reserve); Benjamin Wittels, M.D.(Minnesota).

Associate Professors

Dolph O. Adams, M.D., Ph.D.(North Carolina at Chapel Hill); Edward H. Bossen, M.D.(Duke); William D. Bradford, M.D.(Western Reserve); Peter C. Burger, M.D.(Northwestern); Charles Daniels, M.D., Ph.D.(Duke); Jane G. Elchlepp, Ph.D.(Chicago), M.D.(Iowa); Doyle G. Graham, M.D., Ph.D.(Duke);

John D. Shelburne, M.D., Ph.D.(Duke); Craig Tisher, M.D.(Washington Univ.); Frances K. Widmann, M.D.(Western Reserve); Peter Zwadyk, Jr., Ph.D.(Iowa).

Adjunct Associate Professor

John A. Moore, D.V.M.(Michigan State).

Assistant Professors

Peter Anderson, Ph.D.(Oregon); Byron P. Crocker, Jr., M.D., Ph.D.(Duke); Hal Hawkins, M.D., Ph.D.(Duke); Carol W. Lewis, Ph.D.(North Carolina at Chapel Hill); Kenneth Scott McCarty, Jr., M.D., Ph.D.(Duke); George Michalopoulos, M.D., Ph.D.(Wisconsin); Salvatore V. Pizzo, M.D., Ph.D.(Duke); Keith Arnold Reimer, Ph.D., M.D.(Northwestern); Robin T. Vollmer, M.D.(Duke).

Adjunct Assistant Professor

Arnold Ralph Brody, Ph.D.(Colorado State).

The Department of Pathology offers graduate work leading to the M.S. and Ph.D. degrees with areas of specialization such as subcellular and molecular pathology. Course work is designed to give a broad background in classical and modern pathology with emphasis on the application of modern research techniques. Students will be required to take such courses as are necessary to obtain a broad foundation, as well as courses applicable to areas of speciality and research. Further information including brochures giving details of departmental facilities, staff, trainee stipends, and the M.D.-Ph.D. program are available from the Director of Graduate Studies.

Courses of Instruction

219. Molecular and Cellular Bases of Development; 219S. Seminar; 250. General Pathology; 251. Laboratory Course in General Pathology; 258. Cellular and Subcellular Pathology; 275. Fundamentals of Electron Microscopy; 325. Cardiovascular Pathology; 352. Basic Problems in Chemical Pathology; 353. Advanced Neuropathology; 355, 356. Graduate Seminar in Pathology; 357. Research in Pathology; 360. Cytochemistry; 361, 362. Autopsy Pathology; 364. Systemic Pathology; 367, 368. Special Topics in Pathology; 369. Ophthalmic Pathology; 370. Developmental Pathology and Teratology; 374. Pulmonary Pathology and Postmortem Pathophysiology; 377. Pathology of the Kidney; 379. Pathology of Virus Infections; 381. Interdisciplinary Seminars in Cancer Research.

Pharmacology

Professors

F. Bernheim, Ph.D.(Cambridge, England), *James B. Duke Professor Emeritus of Pharmacology*; Norman Kirshner, Ph.D.(Pennsylvania State), *Chairman*; Leon Lack, Ph.D.(Columbia); Robert Arthur Maxwell, Ph.D.(Princeton); Daniel B. Menzel, Ph.D.(California at Berkeley); Charles Adam Nichol, Ph.D.(Wisconsin); Athos Ottolenghi, M.D.(Univ. of Pavia, Italy); Saul M. Schanberg, Ph.D., M.D.(Yale); David G. Shand, Ph.D., M.B.(St. Bartholomew's Hospital Medical College); Pelham Wilder, Jr., Ph.D.(Harvard).

Associate Professors

James Norman Davis, M.D.(Cornell); Elliott Mills, Ph.D.(Columbia), *Director of Graduate Studies*; Gerald M. Rosen, Ph.D.(Clarkson Coll. of Tech.); Theodore A. Slotkin, Ph.D.(Rochester); Osvaldo Humberto Viveros, M.D.(Univ. of Chile).

Assistant Professors

Mohamed Bahie Abou-Donia, Ph.D.(California at Berkeley); Thorir D. Bjornsson, M.D.(Iceland); P. Michael Conn, Ph.D.(Baylor); Everett H. Ellinwood, Jr., M.D.(North Carolina at Chapel Hill); Cynthia Moreton Kuhn, Ph.D.(Duke); Jeffrey David Lazar, M.D.(Michigan); J. Victor Nadler, Ph.D.(Yale); Donald H. Namm, Ph.D.(Albany Med. Coll.); Brij Bhushan Shrivastar, Ph.D.(Western Ontario, Canada); Harold C. Strauss, M.D.(McGill); A. Richard Whorton, Ph.D.(Vanderbilt).

Adjunct Assistant Professors

Donald E. Gardner, Ph.D.(Cincinnati); Wilkie A. Wilson, Ph.D.(Duke).

The Department of Pharmacology offers graduate work leading to the Ph.D. degree. The department considers a strong background in basic science as necessary, serious consideration being given to candidates with majors in biology, chemistry, mathematics, and physics. There is no foreign language requirement.

Courses of Instruction

210, 211. Individual Study and Research; 219. Tutorial in Pharmacology; 250. Pharmacology; 256. Human Nutrition; 270. Neurobiology 1; 271. Neurobiology 2; 280. Student Seminar in Pharmacology; 282. Teaching Methods in Pharmacology; 330. Pharmacological Basis of Clinical Medicine; 331. Laboratory Methods in Pharmacology; 333. Principles of Pharmacology and Toxicology, I; 334. Principles of Pharmacology and Toxicology, II; 335. Drug Receptor Theory; 354. Mammalian Toxicology; 360. Neuropharmacology; 372. Research in Pharmacology; 417. Cellular Endocrinology.

Philosophy

Professors

Martin P. Golding, Ph.D.(Columbia), *Chairman*; Edward P. Mahoney, Ph.D.(Columbia); William Bernard Peach, Ph.D.(Harvard); David H. Sanford, Ph.D.(Cornell), *Director of Graduate Studies*; Paul Welsh, Ph.D.(Cornell).

Associate Professor

George W. Roberts, Ph.D.(Cambridge).

Assistant Professors

John Fjeld, Ph.D.(Univ. of Toronto); David J. Ross, Ph.D.(Stanford); Thomas E. Wartenberg, Ph.D.(Pittsburgh).

The Department of Philosophy offers graduate work leading to the A.M. and Ph.D. degrees. Tutorial work complements formal instruction. Students may specialize in any of the following fields: the history of philosophy, logic, philosophy of science, epistemology, metaphysics, philosophy of the mind, philosophical analysis, ethics, aesthetics, political philosophy, philosophy of law, philosophy of medicine, and philosophy of religion.

Individual programs of study are developed for each student. The following requirement, however, is fundamental: the preliminary examination for the Ph.D., which may be taken only after a student has met the language requirement for that degree, should be taken after the second year of study. In these examinations students are expected to combine historical knowledge with critical understanding.

Work in a minor or related field, not necessarily confined to any one department, is encouraged but not required. A minor normally includes 6 units for

the A.M. or the Ph.D. degree and may include more as a student's program requires or permits.

A student who meets the general requirements of the Graduate School for the A.M. degree may earn this degree by satisfying the foreign language requirement and by passing the preliminary examination for the Ph.D. degree or by writing and successfully defending a master's thesis.

A reading knowledge of at least one foreign language, ancient or modern, is required for the Ph.D. degree. Students may not take their preliminary examinations until they have demonstrated this ability. More than one language may be required where this is judged appropriate to the research demanded by the candidate's dissertation.

Courses of Instruction

202S. Aesthetics: The Philosophy of Art; 203S. Contemporary Ethical Theories; 204S. Philosophy of Law; 205S. Philosophy of History; 206S. Responsibility; 208S. Political Values; 211S. Plato; 217S. Aristotle; 218S. Medieval Philosophy; 225S. British Empiricism; 227S. Continental Rationalism; 228S. Recent and Contemporary Philosophy; 230S. The Meaning of Religious Language; 231S. Kant's Critique of Pure Reason; 232S. Recent Continental Philosophy; 233S. Methodology of the Empirical Sciences; 234S. Problems in the Philosophy of Science; 241S. Topics in Logical Theory; 251S. Epistemology; 252S. Metaphysics; 253S. Philosophy of Mind; 254S. Philosophy of Religion; 255S. Philosophy of Action; 260S. Wittgenstein; 291S, 292S. Seminar in Special Fields of Philosophy; 331, 332. Seminar in Special Fields of Philosophy.

Physical Therapy

Professor

Robert Charles Bartlett, M.A.(New York Univ.), *Chairman*.

Associate Professors

Eleanor F. Branch, Ph.D.(Duke), *Director of Graduate Studies*; Elia E. Villanueva, A.M.(Duke).

Assistant Clinical Professors

Elaine M. Eckle, M.A.(North Carolina at Chapel Hill); Mary Ellen Riordan, M.S.(Wisconsin).

Associates

Marjory A. Cannon, M.M.Sc.(Emory); Linda K. George, Ph.D.(Duke); Mary Martin Huse, Ph.D.(Duke).

The Department of Physical Therapy offers a basic professional program leading to the M.S. degree. To be eligible for admission to the program, applicants must have obtained a baccalaureate degree and have a background in the basic sciences and social sciences including course work in biology, chemistry, physics, psychology, and statistics. In the first year of the curriculum students are required to take courses in anatomy offered by that department. Further information may be obtained from the Director of Graduate Studies, Department of Physical Therapy, Box 3965, Duke University Medical Center, Durham, N.C. 27710.

Courses of Instruction

201, 202. Seminar in Physical Therapy; 217. Physical Therapy Dynamics I; 218. Physical Therapy Dynamics II; 220. Physical Therapy Dynamics III; 230,

231. Physical Evaluation and Instrumentation; 234. Introductory Pathology; 236, 237. Medical Sciences; 240. Prosthetics and Orthotics; 242. Directed Clinical Experience in Physical Therapy I; 243, 244. Directed Clinical Experience in Physical Therapy II; 297, 298. Special Topics in Physical Therapy; 301. Introduction to Scientific Inquiry; 332. Administration of Physical Therapy Services; 350. Research.

Physics

Professors

L. C. Biedenharn, Jr., Ph.D.(Massachusetts Inst. of Tech.); Edward G. Bilpuch, Ph.D.(North Carolina at Chapel Hill); Ron Y. Cusson, Ph.D.(California Inst. of Tech.); Henry A. Fairbank, Ph.D.(Yale); Walter Gordy, Ph.D.(North Carolina at Chapel Hill), LL.D., D.H.C., *James B. Duke Professor of Physics*; Harold W. Lewis, Ph.D.(Duke); Horst Meyer, *Docteur es sciences* (Geneva); Moo-Young Han, Ph.D.(Rochester); Henry W. Newson, Ph.D.(Chicago), *James B. Duke Professor of Physics*; N. Russell Roberson, Ph.D.(Johns Hopkins); Hugh G. Robinson, Ph.D.(Duke); William D. Walker, Ph.D.(Cornell), *Chairman*; Richard L. Walter, Ph.D.(Notre Dame).

Associate Professors

Frank C. DeLucia, Ph.D.(Duke); Lawrence E. Evans, Ph.D.(Johns Hopkins), *Director of Graduate Studies*; Lloyd R. Fortney, Ph.D.(Wisconsin); Alfred T. Goshaw, Ph.D.(Wisconsin).

Assistant Professors

Dewey T. Lawson, Ph.D.(Duke); Peter W. Lucas, Ph.D.(Yale); Charles E. Nelson, Ph.D.(Ohio); Richard G. Palmer, Ph.D.(Illinois); Robert Kent Smith, Jr., Ph.D.(Maryland); Stephen A. Wender, Ph.D.(Iowa).

Adjunct Professors

Mikael N. Ciftan, Ph.D.(Duke); Fearghus O'Foghludha, Ph.D.(National Univ. of Ireland); Herman Robl, Ph.D.(Vienna); Katherine Way, Ph.D.(North Carolina at Chapel Hill).

The Department of Physics offers graduate work for students wishing to earn the A.M. or Ph.D. degree. In addition to a balanced program of basic graduate courses, the department offers specialized courses and seminars in several fields, in which research is being done by students, faculty, and staff.

With the help of faculty advisers, students select a course program to fit their needs, including work in a related field, usually mathematics or chemistry. Students are encouraged to begin research work early in their careers.

The department does not ordinarily accept students for work toward the A.M. degree only, and students making good progress are advised to work directly for the Ph.D. degree. The option of taking the A.M. without thesis is available with the approval of a departmental committee.

Courses of Instruction

211, 212. Advanced Modern Physics; 215. Introduction to Quantum Mechanics; 217S, 218S. Advanced Physics Laboratory and Seminar; 220. Electronics; 223. Electricity and Magnetism; 240. Computer Application to Physical Measurement; 280. Nuclear Reactor Physics; 282. Mechanics of Continuous Media; 302. Advanced Mechanics; 303. Statistical Mechanics; 304. Advanced Topics in Statistical Mechanics; 305. Introduction to Nuclear Physics; 306. Low Tempera-

ture Physics; 308. Introduction to High Energy Physics; 309. Solid State Physics I; 310. Solid State Physics II; 312. Phase Transitions and Critical Phenomena; 316. Principles of Quantum Theory; 317. Intermediate Quantum Theory; 318. Electromagnetic Field Theory; 330. Nuclear Structure Theory; 331. Microwave Radiation; 335. Microwave Spectroscopy; 341. Advanced Topics in Quantum Theory; 342. Theory of Elementary Particles; 343. Nuclear Physics; 344. Advanced Nuclear Physics; 345. High Energy Physics; 346. Topics in Theoretical Physics; 351, 352. Seminar; 397, 398. Low Temperature and Solid State Seminar.

Physiology

Professors

J. J. Blum, Ph.D.(Chicago); Irving Diamond, Ph.D.(Chicago); F. Jöbsis, Ph.D.(Michigan); E. A. Johnson, M.D.(Sheffield), *Chairman*; P. K. Lauf, M.D.(Freiburg); Melvyn Lieberman, Ph.D.(State Univ. of New York, Downstate Med. Center), *Director of Graduate Studies*; J. W. Moore, Ph.D.(Virginia); J. V. Salzano, Ph.D.(Iowa); G. Somjen, M.D.(New Zealand); Madison S. Spach, M.D.(Duke).

Associate Professors

N. C. Anderson, Ph.D.(Purdue); Peter Brian Bennett, Ph.D.(Southampton); Robert P. Erickson, Ph.D.(Brown); Joseph C. Greenfield, M.D.(Emory); J. Gutknecht, Ph.D.(North Carolina at Chapel Hill); Johannes A. Kylstra, M.D., Ph.D.(Leiden); Harold E. Lebovitz, M.D.(Pittsburgh); T. J. McManus, M.D.(Boston); Lazaro J. Mandel, Ph.D.(Pennsylvania); L. M. Mendell, Ph.D.(Massachusetts Inst. of Tech.); E. Mills, Ph.D.(Columbia); G. M. Padilla, Ph.D.(California at Los Angeles); James M. Schooler, Jr., Ph.D.(Wisconsin); David W. Schomberg, Ph.D.(Purdue); Howard Wachtel, Ph.D.(New York Univ.); M. Wolbarsht, Ph.D.(Johns Hopkins).

Assistant Professors

Reginald D. Carter, Ph.D.(Bowman Gray); C. Russell Horres, Jr., Ph.D.(Duke); Fidel Ramón, Ph.D.(Duke); Sidney A. Simon, Ph.D.(Northwestern); Andrew G. Wallace, M.D.(Duke).

Adjunct Assistant Professor

Philip A. McHale, Ph.D.(Duke).

Assistant Medical Research Professors

Page A. W. Anderson, M.D.(Duke); Gilbert Baumann, Dr. Sc.(Swiss Federal Inst. of Tech.); Hie Ping Beall, Ph.D.(Tulane); Michael Lee Hines, Ph.D.(Chicago).

The Department of Physiology offers graduate work leading to the Ph.D. degree. Before undertaking this program a student should have a strong background in basic sciences including course work in mathematics, biology, physics, and chemistry through physical chemistry. Undergraduates with this background may have majors in any of the following areas: biology, chemistry, physics, mathematics engineering or computer sciences. There is no foreign language requirement.

Courses of Instruction

200. Introduction to the Physiology of Man; 204. Introduction to Modern Physiology; 207. The Heart in Health and Disease; 208. Respiratory System in Health and Disease; 210. Individual Study; 212. Membrane Physiology and Osmoregulation; 216. Contractile Processes; 217. Membrane Transport; 221.

Electrophysiological Techniques; 230. Molecular and Cellular Bases of Development; 230S. Seminar; 240. Seminars in Physiology; 260. Cell Growth and Differentiation; 270. Neurobiology 1; 272. Neurobiology 2; 280. Student Seminar in Physiology; 281. Teaching in Physiology; 301. Oxygen Physiological Function; 320. Gastrointestinal Physiology; 321. Renal Physiology; 362. Cardiac Muscle Physiology; 372. Research in Physiology; 383. Physiological Instrumentation; 401. Metabolic Physiology; 416. Biophysics of Excitable Membranes; 417. Cellular Endocrinology; 418. Reproductive Biology; 419. Topics in Mathematical Physiology; 420. Cellular Immunophysiology.

Political Science

Professors

James David Barber, Ph.D.(Yale); Ralph Braibanti, Ph.D.(Syracuse), *James B. Duke Professor of Political Science*; Frederic N. Cleaveland, Ph.D.(Princeton); Kazimierz Grzybowski, S.J.D.(Harvard); Hugh Marshall Hall, Jr. Ph.D.(Texas), *Director of Graduate Studies*; John Hamilton Hallowell, Ph.D.(Princeton); Ole R. Holsti, Ph.D.(Stanford), *Chairman*; Jerry F. Hough, Ph.D.(Harvard); Allan Kornberg, Ph.D.(Michigan); Richard H. Leach, Ph.D.(Princeton).

Associate Professors

Albert Eldridge, Ph.D.(Kentucky); Peter Fish, Ph.D.(Johns Hopkins); Willis F. Hawley, Ph.D.(California at Berkeley); Sheridan Johns III, Ph.D.(Harvard); David Paletz, Ph.D.(California at Los Angeles); David E. Price, B.D., Ph.D.(Yale); Ronald L. Rogowski, Ph.D.(Princeton); Lester M. Salamon, Ph.D.(Harvard); Thomas A. Spragens, Ph.D.(Duke); Arturo Valenzuela, Ph.D.(Columbia).

Assistant Professors

David J. Falcone, Ph.D.(Duke); Joseph J. Kruzel, Ph.D.(Harvard); Margaret A. McKean, Ph.D.(California at Berkeley).

Lecturers

Jean F. O'Barr, Ph.D.(Northwestern).

The Department of Political Science offers graduate work leading to the A.M. and Ph.D. degrees. Before being admitted to candidacy for the Ph.D. degree, an applicant is normally expected to have qualified for the A.M. degree.

Instruction is designed to prepare the student for teaching and research, for government service, and for other work related to public affairs. Before undertaking graduate study in political science, a student is ordinarily expected to have completed at least 12 semester hours of course work in political science, including some work in American government. Instruction is currently offered in the following fields: American government and politics, comparative government and politics, political theory, international relations, and empirical theory and methodology.

The candidate for the degree of Doctor of Philosophy in political science must take at least twelve courses in the department and demonstrate competence in at least two general fields of the discipline as well as in a third general field or in a specialized subfield or in a field external to the department. The candidate must also demonstrate a reading knowledge of two foreign languages or must demonstrate proficiency in one such foreign language and in the use of statistics.

Further details on the graduate program in political science, the departmental facilities, the staff, and available financial aid may be obtained from the Director of Graduate Studies, Department of Political Science.



Courses of Instruction

201. Arms Control and Defense Strategy; 204. Ethics in Political Life; 206. Politics and the Media; 207. American Constitutional Interpretation; 209. Problems in State Government and Politics; 210. The Politics of Education; 211S. Current Problems and Issues in Japanese Politics; 212. Japanese Foreign Policy; 215. Comparative Legislative Processes; 216S. Comparative Politics of the Welfare State; 217S. Economic Theories of Political Behavior; 218S-219S. Political Thought in the United States; 220S. Problems in International Politics; 221. International Organization; 222. Empirical Theory; 223. Political Philosophy from Plato to Machiavelli; 224. Modern Political Theory; 225. Comparative Government and Politics: Western Europe; 226. Theories of International Relations; 227. International Law; 229. Recent and Contemporary Political Theory; 230. American National Government; 231. American Political Theory; 233. Research Methodology; 234S. Political Economy of Development: Theories of Change in the Third World; 235. The Commonwealth; 236. Statistical Analysis; 238. Comparative Foreign Policy; 239S. Current Problems of International Law; 241. Public Administrative Organization and Management; 243. Applications of Administrative and Organizational Theory; 244. Administrative Law and Process; 245S. Ethics and Policy-Making; 246. Administration and Public Policy; 247. Political Participation and Policy Outcomes; 248. The Politics of the Policy Process; 249. Comparative International Development and Technology Flow; 250. Comparative Government and Politics: Southern Asia; 252. Comparative Political Behavior and Socialization; 253. Comparative Government and the Study of Latin America; 257S, 258S. Modern East Asia. Introduction to Problems and Literature; 260. The Tradition of Political Inquiry; 273S. The American South as a "Developing Society"; 274. Political Psychology; 275. The American Party System; 277. Comparative Party Politics; 278. Canadian Political Behavior in the North American Context; 280. Comparative Government and Politics: Sub-Saharan Africa; 282S. Seminar on Canada; 283S. Congressional Policy-Making; 285. The Judicial Process; 291. Problems of Urban Government; 293. Federalism; 301. Teaching Political Science; 303. Seminar on Selected Topics in Statistics; 306. Seminar in Politics and the Mass Media of Communication; 307. Graduate Seminar in American Voting Behavior; 308. Individual Research in Political Science; 309. Seminar in International Relations; 310. Seminar in State and Local Government; 312. Seminar in Constitutional Law; 313. Education and Public Policy; 321. Seminar in Political Theory; 322. Seminar in Selected Topics in Empirical and Formal Theory; 323. Seminar in Modern Political Theory; 325. Seminar in Comparative Government and Politics; 329. Seminar in International Regional Organization; 330. Seminar in Comparative Government and Politics—Southern Asia; 331. Seminar in American Political Thought; 340. Seminar in American Politics and Institutions; 341. Seminar in Public Administration; 342. Seminar in American National Government and Politics; 343. Seminar in the Policy Process; 344. Workshop on Computer Models of Social Systems; 360. Seminar in Government and Politics in the Soviet Union; 361. Seminar in Foreign Relations of the Soviet Union; 376. Seminar in Comparative Political Behavior; 380. Seminar in African Government and Politics; 381. Research Seminar in Latin American Government and Politics; 382. Soviet Law and Society; 401. Seminar in the Commonwealth; 402. Interdisciplinary Seminar in the History of the Social Sciences.

Psychology

Professors

Irving Emanuel Alexander, Ph.D.(Princeton); William Bevan, Ph.D.(Duke), *William Preston Few Professor of Psychology*; Lloyd Joseph Borstelmann, Ph.D.(California at Berkeley); Robert Charles Carson, Ph.D.(Northwestern); Irving Thomas Diamond, Ph.D.(Chicago), *James B. Duke Professor of Psychology*; Carl John Erickson, Ph.D.(Rutgers), *Director of Graduate Studies*; Robert Porter Erickson, Ph.D.(Brown); Norman Guttman, Ph.D.(Indiana); Gregory A. Kimble, Ph.D.(State Univ. of Iowa), *Chairman*; Martin Lakin, Ph.D.(Chicago); Gregory Roger Lockhead, Ph.D.(Johns Hopkins); Harold Schiffman, Ph.D.(Princeton); John Staddon, Ph.D.(Harvard); Michael A. Wallach, Ph.D.(Harvard); Cliff Waldron Wing, Jr., Ph.D.(Tulane).

Associate Professors

John C. Coie, Ph.D.(California at Berkeley); Philip R. Costanzo, Ph.D.(Florida); Ruth S. Day, Ph.D.(Stanford); William C. Hall, Ph.D.(Duke); John B. McConahay, Ph.D.(California at Los Angeles).

Assistant Professors

Clifford A. Butzin, Ph.D.(California at San Diego); John H. Casseday, Ph.D.(Indiana); Carol Eckerman, Ph.D.(Columbia); Irwin Kremen, Ph.D.(Harvard); Alan S. Levy, Ph.D.(Columbia); G. M. Robinson, Ph.D.(Chicago); Susan Roth, Ph.D.(Northwestern); David Charles Rubin, Ph.D.(Harvard); Christopher G. Wetzel, Ph.D.(North Carolina at Chapel Hill); Timothy D. Wilson, Ph.D.(Michigan).

Lecturers

Patrick A. Boudewyns, Ph.D.(Wisconsin); H. Keith H. Brodie, M.D.(Columbia); Herbert Floyd Crovitz, Ph.D.(Duke); W. Doyle Gentry, Ph.D.(Florida State); Gail R. Marsh, Ph.D.(Iowa); Ronald W. Oppenheim, Ph.D.(Washington); Susan S. Schiffman, Ph.D.(Duke); George G. Somjen, M.D.(New Zealand); Lise Wallach, Ph.D.(Kansas); M. L. Wolbarsht, Ph.D.(Johns Hopkins).

The department offers work leading to the Ph.D. degree. The areas of concentration are experimental, biological, cognitive, social, personality, developmental, and clinical psychology. Students in experimental, biological, and cognitive psychology should have a strong undergraduate background in the basic sciences: mathematics, physics, biology, and chemistry.

A brochure is available from the Director of Graduate Studies which describes the program in more detail and gives information on financial assistance, facilities, and current research activity.

Courses of Instruction

203. Sensation and Perception; 210. Cognitive Psychology; 211. Human Thinking; 212. Human Memory; 213. Adaptive Behavior; 214. Development of Social Interaction; 215. Cognitive Development; 216. Biological Psychology; 217. Social Psychology; 218. Research Methods in Social Psychology; 219. Neural Bases of Behavior; 230. Social Behavior of Animals; 232. Group Processes and Group Development; 234. Seminar in Personality; 238S. Electroencephalogram and Psychological Function; 245. Personality Theory; 253. Psychological Approaches to Public Policy Analysis; 260. Science, Technology, and Society; 261. Science, Politics, and Government; 271S. Selected Problems; 273, 274. Statistical Principles in Experimental Design; 277. Neuroanatomical Basis of Behavior; 283, 284. The History of Psychology; 286S. Psychophysiology of

Hearing; 305. Psychopathology; 306. Seminar in Developmental Psychology; 307. Introduction to Methods in Psychotherapy; 309. Seminar in Learning; 310. Seminar in Perception; 314. Seminar in Instrumental Behavior; 317. Seminar in Social Behavior; 319-320. Research Apprenticeship I; 325. Seminar in Animal Behavior; 329-330. Pro-Seminar in Psychology; 331-332. Research Apprenticeship II; 333, 334. Seminar: Behavioral Studies of the Brain; 335-336. Clinical Inquiry I; 337. Seminar in Sensory Discrimination; 338. Pictorial Representation and Iconic Communication; 340. Group Processes and Group Therapy; 343-344. Clinical Inquiry II; 350. Practicum in Psychological Research.

Public Policy Sciences

Professors

Joel Lawrence Fleishman, LL.B.(Yale), *Director*; Jerry F. Hough, Ph.D.(Harvard); David L. Lange, LL.B.(Illinois).

Associate Professors

Robert D. Behn, Ph.D.(Harvard); Colin C. Blaydon, Ph.D.(Harvard); Walter DeVries, Ph.D.(Michigan State); Saul Friedman, M.A.(Rile Inst.); Paul B. Ginsburg, Ph.D.(Harvard); Lawrence C. Goodwyn, Ph.D.(Texas); Henry G. Grabowski, Ph.D.(Princeton); Willis D. Hawley, Ph.D.(California at Berkeley); John B. McConahay, Ph.D.(California at Los Angeles), *Associate Director*; Michael P. Murray, Ph.D.(Iowa State); David E. Price, B.D., Ph.D.(Yale); Lester M. Salamon, Ph.D.(Harvard); Carol B. Stack, Ph.D.(Illinois).

Assistant Professors

Philip J. Cook, Ph.D.(California at Berkeley), *Director of Graduate Studies*; Peter R. Decker, Ph.D.(Columbia); Mark R. Eaker, Ph.D.(Stanford); Joseph Lipscomb, Jr., Ph.D.(Vanderbilt); Daniel S. Nagin, Ph.D.(Carnegie-Mellon); James W. Vaupel, Ph.D.(Harvard).

Lecturer

Bruce L. Payne, M.A.(Yale).

Visiting Professors

Robert Coles, M.D.(Columbia); James C. Wallace, J.D., M.S.(North Carolina at Chapel Hill).

The graduate program in public policy sciences is offered through the Institute of Policy Sciences and Public Affairs. The objective of the program is to prepare students for public sector jobs which require analytical skills and a practical understanding of the processes by which policy is made and implemented.

The A.M. degree requires two academic years and a summer internship. The first year is devoted to core courses in policy analysis, including sequences in quantitative methods, economics, political analysis, and ethics. The summer internship is arranged with a federal or state agency. The second year curriculum includes course work in public management, a concentration in a substantive policy area, and a masters "memo" to be researched and written on a problem of current policy concern.

Students who are concurrently enrolled in a Ph.D. program or a professional degree program (M.D., J.D., M.B.A., M.H.A., etc.) or who have already obtained such a degree, can apply for an abbreviated version of the A.M. program. Such students are excused from all the requirements of the second year except for the masters memo, so ordinarily completing the A.M. requirements adds only one year

to their graduate programs. Students usually apply for a joint degree program simultaneously with their applications to the graduate departments or professional schools, or during their first or second year of advanced study.

The Institute does not award a Ph.D.

More information concerning the A.M. programs can be obtained by writing the Director of Graduate Studies.

Courses of Instruction

204. Ethics in Political Life; 215S. Public Policies to Save Lives; 216S. Comparative Politics of the Welfare State; 217. Microeconomics and Public Policy-Making; 219. The Politics of the Policy Process; 221. Analytical Methods I: Decision Analysis for Public Policy-Makers; 222. Analytical Methods II: Data Analysis for Public Policy-Makers; 223S. Ethics and Policy-Making; 224. Applications of Administrative and Organizational Theory; 231. Analytical Methods III: Quantitative Policy Evaluation; 232. Analytical Methods IV: Topics in Economic Policy; 233. Analytic Approaches to Bargaining, Cooperation, and Competition; 236S. Public Financial Management; 246. Population Policy; 247. Political Participation and Policy Outcomes; 250. Public Policy and the Arts; 252S. National Security Policy; 253. Psychological Approaches to Public Policy; 254. Transportation Planning and Policy Analysis; 255. Science, Politics, and Government; 256. The Economics of Health Care; 260S. Public Policy Research Seminar: The Administration of Justice; 261S. Research Seminar: Health Policy; 262S. Communication Policy and the Law; 263S. Public Policy Research Seminar: Urban and Regional Development Policy; 264S. Public Policy Research Seminar: Topics in Public Policy I; 265S. Seminar in Selected Public Policy Topics; 270S. Humanistic Perspectives on Public Policy; 271. The Uses of History in Public Policy: I; 272. Poverty in the United States: A Historical Perspective; 273S. The Uses of History in Public Policy II; 274. Mental Health Policy and American Culture; 275. Class, Ethnicity, and Social Policy; 276S. National Policies and the Family; 277. Sex Discrimination and the Law; 284S. Research Seminar in Communications Policy; 301. Public Policy Workshops; 302. Public Policy Workshop; 387. Research Tutorial in Public Policy; 388. Research Tutorial in Public Policy; 391. Multinational Corporations Seminar; 399. Special Readings in Public Policy Sciences.

Religion

Professors

Frank Baker, B.D., Ph.D.(Nottingham); W. Waldo Beach, B.D., Ph.D.(Yale); David Bradley, Ph.D.(Yale); Robert E. Cushman, B.D., Ph.D., L.H.D.(Yale); William David Davies, B.D., M.A., D.D.(Wales), *George Washington Ivey Professor of Advanced Studies in New Testament and Research in Christian Origins*; Stuart C. Henry, B.D., Ph.D.(Duke); Frederick L. Herzog, Th.D.(Princeton); Wesley A. Kort, Ph.D.(Chicago); Creighton Lacy, B.D., Ph.D.(Yale); Thomas A. Langford, B.D., Ph.D.(Duke); C. Eric Lincoln, Ph.D.(Boston); Charles H. Long, Ph.D.(Chicago); Roland E. Murphy, S.T.D.(Catholic Univ.); Robert Osborn, B.D., Ph.D.(Drew); William H. Poteat, B.D., Ph.D.(Yale), *Chairman*; James L. Price, Jr., B.D., Ph.D.(Cambridge); D. Moody Smith, Jr., B.D., Ph.D.(Yale), *Director of Graduate Studies*; Harmon L. Smith, B.D., Ph.D.(Duke); David Curtis Steinmetz, Th.D.(Harvard); Orval Wintermute, B.D., Ph.D.(Johns Hopkins); Franklin W. Young, B.D., Ph.D.(Duke), *Amos Ragan Kearns Professor of New Testament and Patristic Studies*.

Associate Professors

Lloyd Richard Bailey, Ph.D.(Hebrew Union Coll.); Kalman P. Bland, Ph.D.(Brandeis); James H. Charlesworth, Ph.D.(Duke); Roger J. Corless, Ph.D.(Wisconsin); Robert C. Gregg, Ph.D.(Pennsylvania); Bruce B. Lawrence, Ph.D.(Yale); Eric M. Meyers, Ph.D.(Harvard); Harry B. Partin, Ph.D.(Chicago); Jill Raitt, Ph.D.(Chicago).

The Department of Religion offers graduate work leading to the A.M. and Ph.D. degrees. Students may major in one of four fields: (1) Biblical studies; (2) historical studies; (3) systematic and contemporary studies; and (4) history of religions. They will be expected to take such courses in one or more of the other fields which will contribute to an adequate understanding of their chosen fields of specialization.

In addition to course work in these major fields, students will take such other courses in cognate fields as will contribute to the enrichment of their major studies. This minor requirement may be fulfilled either by work in a cognate department, such as classical studies, history, philosophy, political science, or sociology, or by work in a cognate field within the Department of Religion other than the field of major concentration.

The program of doctoral studies presumes a foundation in the academic study of religion. Students applying for graduate work in religion directly from an undergraduate program should have had a strong undergraduate major in religion, and will be accepted for the Ph.D. program only upon the satisfactory completion of the A.M. degree with the department.

Courses of Instruction

FIELD I. BIBLICAL STUDIES

207, 208. Intermediate Biblical Hebrew; 209. Old Testament Theology; 220. Rabbinic Hebrew; 221. Readings in Hebrew Biblical Commentaries; 223A. Exegesis of the Hebrew Old Testament: Amos and Hosea; 223B. Exegesis of the Hebrew Old Testament: Job; 223C. Exegesis of the Hebrew Old Testament: Exodus; 223D. Exegesis of the Hebrew Old Testament: Song of Songs; 223E. Exegesis of the Hebrew Old Testament: Ecclesiastes; 225. Living Issues in New Testament Theology; 226A. Exegesis of the Greek New Testament I (Mark and Matthew); 226B. Exegesis of the Greek New Testament I (Romans); 226D. Exegesis of the Greek New Testament I (I and II Corinthians); 226E. The Gospel and Epistles of John; 227A. Exegesis of the Greek New Testament II (Luke-Acts); 227B. Exegesis of the Greek and New Testament II (Galatians); 227C. Exegesis of the Greek New Testament II (The Pastoral Epistles); 237. History of the Ancient Near East; 239. Introduction to Middle Egyptian; 242. Life After Death in Semitic Thought; 244. The Archaeology of Palestine in Hellenistic-Roman Times; 258. Coptic; 302. Studies in the Intertestamental Literature; 304. Aramaic; 304A. Targumic Aramaic; 306. Language and Literature of the Dead Sea Scrolls; 307. Syriac; 311. Pharisaic Judaism in the First Century; 312. Pauline Theology; 314. Judaism and Christianity in the New Testament; 319. The Gospel According to St. Matthew in Recent Research; 323A. Comparative Semitic I; 323B. Comparative Semitic II; 340-341. Seminar in the New Testament; 345. The Epistle to the Hebrews in Recent Research; 350-351. Old Testament Seminar; 353. Seminar on Text Criticism; 373-374. Elementary Akkadian; 375-376. Elementary Ugaritic; 401. Colloquium in Biblical Studies.

FIELD II. HISTORICAL STUDIES

204. Origen; 206. Christian Mysticism in the Middle Ages; 219. Augustine; 236. Luther and the Reformation in Germany; 238. Jewish Responses to Christianity; 241. Problems in Reformation Theology; 246. Problems in Historical Theology; 247. Readings in Latin Theological Literature; 251. The Counter-Reformation and the Development of Catholic Dogma; 252. Nineteenth and Twentieth-Century Roman Catholic Theology; 260. Seminar: Wesley Studies; 290. Current Problems in Christian Social Ethics; 291. Historical Forms of Protestant Ethics; 296. Religion on the American Frontier; 308. Greek Patristic Texts; 313. The Apostolic Fathers; 315-316. Seminar: History of Religions; 317. Seminar in the Greek Apologists; 318. Seminar in the Greek Fathers; 334. Theology and Reform in the Later Middle Ages; 335. The English Church in the Eighteenth Century; 337. Theology of St. Thomas Aquinas; 338. Calvin and the Reformed Tradition; 339. The Radical Reformation; 344. Zwingli and the Origins of Reformed Theology; 384. Religious Dissent in American Culture; 385. Religion in American Literature; 395. Christian Thought in Colonial America; 396. Liberal Traditions in American Theology.

FIELD III. SYSTEMATIC AND CONTEMPORARY STUDIES

210. Contemporary British Theology; 211. Authority in Theology; 214. The Christian Doctrine of Salvation; 230. The Meaning of Religious Language; 231. Seminar in Religion and Contemporary Thought; 232. Methods in Religion and Literature; 233. Modern Narratives and Religious Meanings; 245. Ethics in World Religions; 248. The Theology of Karl Barth; 262. Marxist Ideology and Christian Faith; 264. The Sociology of the Black Church; 265. The Religions of the West Africa Diaspora; 281. Phenomenology and Religion; 300. Systematic Theology; 320. Theology, Power, and Justice; 322. Nineteenth-Century European Theology; 325. Philosophical Theology I; 326. Philosophical Theology II; 327. Philosophical Method in Religious Studies; 328. Twentieth-Century European Theology; 352. Seminar in Christian Theology; 360. Special Problems in Religion and Culture; 361. Language and Biblical Criticism; 370. Seminar in Religion and Literature; 377. Contemporary American Dramatic Arts and Evolving Theological Forms; 380. Existentialist Thought; 383. Moral Theology in the Twentieth Century; 386. Christianity in Dialogue with Other Faiths; 387. Ethical Method; 388. Ethics and Medicine; 389. Christian Ethics and Contemporary Culture; 394. Christianity and the State; 397. Contemporary American Theology; 398. Colloquium on the College and University Teaching of Religion.

FIELD IV. HISTORY OF RELIGIONS

217. Islam in India; 218. Religion in Japan; 254. Introduction to African Religions; 255. Seminar on African Religions; 280. The History of Religions; 282. Myth and Ritual; 284. The Religion and History of Islam; 286. Religious Trends in the Indian Subcontinent; 287. The Scriptures of Asia; 288. Buddhist Thought and Practice; 315-316. Seminar: History of Religions; 324. Readings in the History of Religion.

Romance Languages

Professors

Thomas Howard Cordle, Ph.D.(Yale); John Morton Fein, Ph.D.(Harvard); Robert Niess, Ph.D.(Minnesota); Marcel Tetel, Ph.D.(Wisconsin), *Chairman*; Bruce

W. Wardropper, Ph.D.(Pennsylvania), *William H. Wannamaker Professor of Romance Languages*.

Associate Professors

Miguel Garci-Gómez, Ph.D.(Catholic Univ.); Alexander Hull, Ph.D.(Washington); Phillip Stewart, Ph.D.(Yale); Patrick R. Vincent, Ph.D.(Johns Hopkins), *Director of Graduate Studies*.

Assistant Professor

Ernesto Caserta, Ph.D.(Harvard).

The Department of Romance Languages offers graduate work leading to the A.M., M.A.T., and Ph.D. degrees in French and Spanish. Requirements for the A.M. may be completed by submission of a thesis or by passing a comprehensive examination in the major field. It is hoped that candidates for the A.M. and Ph.D. degree will take related work in a second Romance language; however, related work may be taken in any one or two of a number of other subject areas.

In order to undertake graduate study in Romance languages, the entering student should have credit for at least 18 semester hours (or equivalent) above the intermediate level in the major language.

Courses of Instruction

FRENCH

210. The Structure of French; 213. French Literature of the Seventeenth Century; 214. The "Moralistes" of the Seventeenth Century; 217. French Symbolism; 219. Old French Literature; 220. French Pre-Romantic and Romantic Poetry; 221, 222. The Nineteenth-Century French Novel; 224. History of the French Language; 225. French Prose of the Sixteenth Century; 226. Topics in Renaissance Poetry; 228. French Poetry of the Twentieth Century; 233. Contemporary French Theater; 234. Proust; 241, 242. French Literature of the Eighteenth Century; 245, 246. French Literature of the Twentieth Century; 311, 312. French Seminar; —. Graduate Reading Course.

ITALIAN

283. Italian Novel of the Novecento; 284. Dante; 285. Dante; 288. The Renaissance.

SPANISH

251. The Origins of Spanish Prose Fiction; 252. Spanish Lyric Poetry Before 1700; 253. The Origins of the Spanish Theater; 255, 256. Modern and Contemporary Spanish American Literature; 257. History of the Spanish Language; 258. Medieval Literature; 260. Origins and Development of Spanish Romanticism; 261. Nineteenth-Century Novel; 262. The Theater of Galdós; 265. Cervantes; 266. Drama of the Golden Age; 270. The Literature of Eighteenth-Century Spain; 275. Modern Spanish Poetry; 276. Modern Spanish Drama; 277. Modern Spanish Novel; 300. Research Materials; 321, 322. Hispanic Seminar.

ROMANCE LANGUAGES

218. The Teaching of Romance Languages.

Slavic Languages and Literatures

Professor

Magnus J. Krynski, Ph.D.(Columbia), *Chairman*.

Associate Professor

Bronislas de Leval Jezierski, Ph.D.(Harvard).

The Department of Slavic Languages and Literatures offers graduate courses in Russian language and literature and limited training in the language and literature of Poland.

Students should have sufficient preparation in the Russian language to enable them to read Russian classical literature in the original.

Courses of Instruction

201, 202. Russian Novel of the Nineteenth Century; 205. The Structure of Polish in Relation to Russian; 206. Readings in Contemporary Polish Prose in the Original; 207. Soviet Literature and Culture; 207P. Preceptorial; 212. Pushkin; 225S. Tolstoy; 227S. Gogol; 230. Chekhov; 230P. Preceptorial; 232. Dostoevsky; 234. Modern Polish Literature.

Sociology

Professors

Kurt W. Back, Ph.D.(Massachusetts Inst. of Tech.), *Chairman*; Alan C. Kerckhoff, Ph.D.(Wisconsin); George L. Maddox, Jr., Ph.D.(Michigan State); John C. McKinney, Ph.D.(Michigan State); George C. Myers, Ph.D.(Washington); Erdman B. Palmore, Ph.D.(Columbia); Alejandro Portes, Ph.D.(Wisconsin); Jack H. Preiss, Ph.D.(Michigan State); Donald F. Roy, Ph.D.(Chicago); Joel Smith, Ph.D.(Northwestern); Edward A. Tiryakian, Ph.D.(Harvard).

Associate Professors

Ida Simpson, Ph.D.(North Carolina at Chapel Hill); Charles Hirschman, Ph.D.(Wisconsin); John Wilson, D.Phil.(Oxford).

Assistant Professors

Richard T. Campbell, Ph.D.(Wisconsin), *Director of Graduate Studies*; Willie Rice, Ph.D.(North Carolina at Chapel Hill).

The department offers graduate work leading to a Ph.D. degree in sociology. Before undertaking advanced work in this department, a student must have completed a minimum of 12 semester hours of approved preliminary courses in sociology, and an additional 12 semester hours in related work. Applicants for admission should submit scores on the Graduate Record Examination, especially the aptitude test.

Increasingly the department is concentrating its training in three programs: sociology of human development; demography and ecology; and social structure and social change. Students who enter without having chosen a program have their first year to do so if entering with the bachelor's degree or their first semester if entering with a master's degree. Each program has its own course requirements,

but all share a six-course requirement covering theory (281) and methodology (295), research methods and techniques (291, 292), and statistics (293, 294). In addition, each program has an informal seminar series and expects extensive student involvement in the research activities of program faculty. All students are expected to participate for training purposes in the teaching program of the department. In order to assure some breadth of training, all students are required to take at least two departmental courses outside the specific course requirements of both their chosen program and the departmental core requirement. Two or four additional courses outside the department in related work are also required.

There is a qualifying procedure after three semesters, or equivalent, to determine whether the student can proceed to the preliminary examination. The latter is an oral examination on a written paper that reviews substantive, theoretical, and empirical aspects of a special field chosen by the student and accepted by the student's examining committee. Further details concerning the general departmental program, the three specialized programs, departmental facilities, the staff, ongoing research, and various stipends available may be obtained from the Director of Graduate Studies.

Courses of Instruction

201. Social Change; 202. Social Organization; 225. Medical Sociology; 230. Social Aspects of Aging and Death; 234S. Political Economy of Development: Theories of Change in the Third World; 241. Social Stratification; 242. The Sociology of Occupations and Professions; 243. Population Dynamics and Social Change; 244. Human Ecology and Urban Systems; 246. Population Policy; 251. The Sociology of Modernization; 254. Urbanization and Social Change; 259. Religion and Social Change; 260. Science, Technology, and Society; 261. Science, Politics, and Government; 272. The Socialization Process; 275. Social Structure and Personality; 276. Small Groups and Social Life; 278. Social Structure and the Life Cycle; 281. Seminar in Sociological Theory; 282S. Seminar on Canada; 291. Research Methods and Techniques I; 292. Research Methods and Techniques II; 293. Introductory Statistical Analysis; 294. Intermediate Statistical Analysis; 295. Methodology in Sociology; 298S, 299S. Seminar in Selected Topics; 301. Seminar in Human Fertility; 302. Seminar in Migration; 325. Social Aspects of Mental Illness and Treatment; 341. Special Problems of Complex Systems; 344. Workshop on Computer Models of Social Systems; 345, 346. Demographic Techniques I and II; 349, 350. Seminar in Selected Topics of Demography and Ecology; 373, 374. Social Psychological Issues in Sociology; 385. Seminar in Sociological Theory; 386. Seminar in Sociological Theory; 390. Seminar in Field Methods of Sociological Research; 392. Individual Research in Sociology; 397, 398. Seminar in Special Research; 402. Interdisciplinary Seminar in the History of the Social Sciences.

Zoology

Professors

Joseph R. Bailey, Ph.D.(Michigan); John D. Costlow, Jr., Ph.D.(Duke); Donald J. Fluke, Ph.D.(Yale); Nicholas W. Gillham, Ph.D.(Harvard); John R. Gregg, Ph.D.(Princeton); Peter H. Klopfer, Ph.D.(Yale); Daniel A. Livingstone, Ph.D.(Yale); R. Bruce Nicklas, Ph.D.(Columbia); Knut Schmidt-Nielsen, Ph.D.(Copenhagen), *James B. Duke Professor of Physiology in Zoology*; Vance A. Tucker, Ph.D.(California at Los Angeles), *Director of Graduate Studies*; Stephen A. Wainwright, Ph.D.(California at Berkeley), *Chairman*; Calvin L. Ward, Ph.D.(Texas); Karl M. Wilbur, Ph.D.(Pennsylvania), *James B. Duke Professor of Zoology*.

Associate Professors

Richard T. Barber, Ph.D.(Stanford); Richard B. Forward, Jr., Ph.D.(California at Santa Barbara); John G. Lundberg, Ph.D.(Michigan); David R. McClay, Ph.D.(North Carolina at Chapel Hill); John P. Sutherland, Ph.D.(California at Berkeley); Steven Vogel, Ph.D.(Harvard); Henry M. Wilbur, Ph.D.(Michigan).

Adjunct Associate Professor

Klaus Schmidt-Koenig, Ph.D.(Freiburg).

Assistant Professors

H. Frederik Nijhout, Ph.D.(Harvard); Mark D. Rauscher, Ph.D.(Cornell); Kenneth B. Storey, Ph.D.(British Columbia).

The Department of Zoology manages a variety of programs tailored to individual needs of students seeking A.M. or Ph.D. degrees.

In general, students entering the department will be equipped to pursue advanced degrees if they have completed an undergraduate major in biology along with some formal training in college-level chemistry, mathematics, physics, and foreign languages.

Nevertheless, in recognition and support of the modern trend toward interdisciplinary research, the department is prepared to accept promising students with less orthodox academic backgrounds and is ready to encourage any student wishing to undertake a program of study leading, in effect, to an interdisciplinary degree sponsored by the department.

Thus, all students are urged to search widely in the *Bulletin of Undergraduate Instruction* and the *Bulletin of the Graduate School* for information about the intellectual resources of the University. Special attention should be given to announcements of the Departments of Anatomy, Anthropology, Biochemistry, Botany, Chemistry, Geology, History, Mathematics, Microbiology and Immunology, Pharmacology, Philosophy, Physiology, Psychology, Sociology, and Zoology; announcements of the Schools of Engineering and Forestry should also be consulted.

Courses of Instruction

201L. Animal Behavior; 203L. Marine Ecology; 204L. Population and Community Ecology; 205. Foundations of Theoretical Biology; 214L. Biological Oceanography; 216L. Limnology; 218L. Pleistocene Paleobiology; 222L. Entomology; 224L. Herpetology; 226L. Ichthyology; 229. Morphogenetic Systems; 235. Evolutionary Systematics; 239S. Biogeography; 244. Principles of Immunology; 245. Radiation Biology; 247S. Photobiology; 249. Biomechanics; 250L. Physiological Ecology of Marine Animals; 252. Comparative Physiology; 258L. Laboratory Research Methods; 260. Advanced Cell Biology; 262L. Cytological Materials and Methods; 265S, 266S. Seminar in Chromosome Biology; 274L. Marine Invertebrate Zoology; 278L. Invertebrate Developmental Biology; 280. Principles of Genetics; 281L. Marine Invertebrate Larvae; 283. Extrachromosomal Inheritance; 286. Evolutionary Mechanisms; 288S. The Cell in Development and Heredity; 289S. Problems in Genetics; 295S, 296S. Seminar; 351, 352. Departmental Seminar; 353, 354. Research; 355, 356. Seminar; 360, 361. Tutorials.



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Graduate School

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Typesetting by Electronic Composition, Inc., Washington, D.C.
Printed by William Byrd Press, Richmond, Virginia

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Calendar of the Graduate School

1979

August

- 1 Wednesday—Final day for filing with the Graduate School office the Statement of Intention to complete requirements for an advanced degree during the summer session. If a thesis is to be presented, the title is to be filed at the same time as the Statement of Intention.
- 11 Friday—Last day for submitting theses for advanced degrees.
- 16–17 Thursday-Friday—Final examinations for Term III.
- 17 Friday—Final date for completion of requirements for Graduate School degrees to be awarded 1 September.
- 17 Friday—Term III ends.

Academic Year 1979–1980

- 27–29 Monday-Wednesday—Registration and matriculation of all new and nonregistered returning students in the Graduate School.
- 27–29 Monday-Wednesday—Consultation with Directors of Graduate Study concerning course programs.
- 28 Tuesday, 9:00 A.M.—English examination for foreign students, 111 Biological Sciences Building. (See chapter on Admission for section on Additional Procedures for Foreign Students.)

September

- 4 Tuesday, 9:00 A.M.—Fall semester classes begin.
- 5 Wednesday, 4:00–6:00 P.M.—Late registration, Intramural Building
- 5 Wednesday, 4:00–6:00 P.M.—Drop/Add begins, Intramural Building.
- 6–7 Thursday-Friday, 8:30–12:30 and 2:00–4:00 P.M.—Drop/Add continues, 127 Allen Building.
- 10–14 Monday-Friday, 8:30–12:30 and 2:00–4:00 P.M.—Drop/Add continues, 127 Allen Building.
- 14 Friday—Final date for changes in registration which involve adding courses, provided no reduction in fees is entailed.
- 28 Friday—Final date for dropping course-seminar registration and adding equivalent units of research.

October

- 5 Friday—Final date for changes in registration resulting from passing the preliminary examination.
- 29–30 Monday-Tuesday—Registration for spring 1980.

November

- 20 Tuesday, 6:00 P.M.—Thanksgiving recess begins.
- 26 Monday, 9:00 A.M.—Classes are resumed.

December

- 6 Thursday, 6:00 P.M.—Fall semester classes end.
- 7–13 Friday-Thursday—Reading period.*
- 9 Sunday—Founders' Day.
- 14 Friday—Final examinations begin.
- 20 Thursday—Final examinations end.

1980

January

- 9 Wednesday, 2:00 P.M.—English examination for foreign students, 208 Old Chemistry. (See chapter on Admission for section on Additional Procedures for Foreign Students.)
- 11 Friday—Registration for new and nonregistered returning students.
- 14 Monday, 9:00 A.M.—Spring semester classes begin.
- 15 Tuesday, 4:00–6:00 P.M.—Late registration, Intramural Building.
- 15 Tuesday, 4:00–6:00 P.M.—Drop/Add begins, Intramural Building.
- 16–18 Wednesday-Friday, 8:30–12:30 and 2:00–4:00 P.M.—Drop/Add continues, 127 Allen Building.
- 21–25 Monday-Friday, 8:30–12:30 and 2:00–4:00 P.M.—Drop/Add continues, 127 Allen Building.

*For 200-level courses, the length of the reading period is at the discretion of the instructor.

- 25 Friday—Final date for changes in registration which involve adding courses, provided that no reduction in fees is entailed.
- February**
- 1 Friday—Final date for filing with the Graduate School office the Statement of Intention of receiving an advanced degree in May. Titles of theses and dissertations are to be filed concurrently with the Statement of Intention.
- 8 Friday—Final date for dropping course-seminar registration and adding equivalent units of research.
- 15 Friday—Final date for change in registration resulting from passing the preliminary examination.
- March**
- 7 Friday, 6:00 P.M.—Spring recess begins.
- 17 Monday, 9:00 A.M.—Classes are resumed.
- 24–25 Monday–Tuesday—Registration for fall and summer 1980.
- April**
- 1 Tuesday—Last day for submitting dissertations for Ph.D. and Ed.D. degrees.
- 15 Tuesday—Last day for submitting theses for A.M., M.S., M.Ed., and M.A.T. degrees.
- 15 Tuesday—Last day for applying to the summer session, Term I, 1980.
- 21 Monday, 6:00 P.M.—Spring semester classes end.
- 22–28 Tuesday–Monday—Reading period.*
- 29 Tuesday—Final examinations begin.
- May**
- 5 Monday—Final examinations end.
- 10 Saturday—Commencement exercises begin.
- 11 Sunday—Baccalaureate services and commencement exercises.
- 15 Tuesday—Final date for completing application for admission to the summer session, Term II, 1980.

*For 200-level courses, the length of the reading period is at the discretion of the instructor



University Administration

General Administration

Terry Sanford, J.D., LL.D., D.H., L.H.D., D.P.A., *President*
A. Kenneth Pye, LL.M., *Chancellor*
William Bevan, Ph.D., *Provost*
Charles B. Huestis, *Vice-President for Business and Finance*
William G. Anlyan, M.D., Sc.D., *Vice-President for Health Affairs*
J. David Ross, J.D., *Vice-President for Institutional Advancement*
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Harold W. Lewis, Ph.D., *Vice-Provost and Dean of Faculty*
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Ewald W. Busse, M.D., Sc.D., *Associate Provost and Dean of Medical and Allied Health Education*
Roscoe R. Robinson, M.D., *Associate Vice-President for Health Affairs and Chief Executive Officer of Duke Hospital*
Frederick C. Joerg, M.B.A., *Assistant Provost for Academic Administration*
Anne Flowers, Ed.D., *Assistant Provost for Educational Program Development*
William J. Griffith, A.B., *Assistant Provost and Dean of Student Affairs*
Clark R. Cahow, Ph.D., *Assistant Provost and University Registrar*
Caroline L. Lattimore, Ph.D., *Dean of Minority Affairs*
Richard L. Wells, Ph.D., *Assistant Provost and Associate Dean of Trinity College of Arts and Sciences*
Joel L. Fleishman, LL.M., *Vice-Chancellor for Public Policy Education and Research, and Director of the Institute for Policy Sciences and Public Affairs*
Mel Ray, M.B.A., *Vice-Chancellor for Data Processing*
Connie R. Dunlap, A.M.L.S., *University Librarian*
William E. King, Ph.D., *University Archivist*
Robert N. Sawyer, Ed.D., *University Educational Planning Officer and Director of Summer Educational Programs*

Graduate School Administration

John C. McKinney, Ph.D., *Dean of the Graduate School*
Charles R. Young, Ph.D., *Associate Dean*
Charles M. Harman, Ph.D., *Associate Dean*
Frances C. Thomas, A.B., *Assistant Dean*
Bonni S. Wallace, M.A., *Assistant to the Dean*

Executive Committee of the Graduate Faculty

Dean John C. McKinney
William L. Culberson (Alt.)
Donald J. Fluke (Alt.)*
Devendra P. Garg (Alt.)*
Walter R. Guild*
Peter W. Jeffs*
Gregory A. Kimble (Alt.)
Holger A. Nygard (Alt.)*
William M. O'Barr*
Leland R. Phelps (Alt.)
Robert A. Pittillo, Jr. (Alt.)*
John V. Salzano
Fredrick L. Thurstone (Alt.)
Patrick R. Vincent*
Richard L. Walter
E. Roy Weintraub
Franklin W. Young

*Term expires September, 1979.

Graduate School Faculty

(As of 1 October 1978.)

The date denotes the first year of service at Duke University.

Mohamed Bahie Abou-Donia (1975), Ph.D., Assistant Professor of Pharmacology
Anne H. Adams (1971), Ed.D., Professor of Education
Dolph O. Adams (1972), M.D., Ph.D., Associate Professor of Pathology
Mark Adelman (1971), Ph.D., Assistant Professor of Anatomy
Irving Alexander (1963), Ph.D., Professor of Psychology
William K. Allard (1975), Ph.D., Professor of Mathematics
A. Tilo Alt (1961–65; 1967), Ph.D., Associate Professor of Germanic Languages and Literature
D. Bernard Amos (1962), M.D., James B. Duke Professor of Immunology
Carl Anderson (1955), Ph.D., Professor of English
C. William Anderson (1978), Ph.D., Assistant Professor of Chemistry
¹Lewis Edward Anderson (1936), Ph.D., Professor of Botany
Nels C. Anderson (1966), Ph.D., Associate Professor of Physiology
Peter Anderson (1974), Ph.D., Assistant Professor of Pathology
Roger Fabian Anderson (1950), Ph.D., Professor of Forest Entomology
²Janis Antonovics (1970), Ph.D., Professor of Botany
Mahadev L. Apte (1965), Ph.D., Associate Professor of Anthropology
James Arthur (1977), Ph.D., Professor of Mathematics
John Leslie Artley (1955), D.Eng., Professor of Electrical Engineering
Kurt W. Back (1959), Ph.D., James B. Duke Professor of Sociology
Joseph Randle Bailey (1946), Ph.D., Professor of Zoology
Lloyd Richard Bailey (1971), Ph.D., Associate Professor of Old Testament
Frank Baker (1960), Ph.D., Professor of English Church History
Kenneth R. Baker (1973), Ph.D., Associate Professor of Business Administration
³Steven W. Baldwin (1970), Ph.D., Associate Professor of Chemistry
Helmy Hamdollah Baligh (1967), Ph.D., Professor of Business Administration
Robert H. Ballantyne (1962), Ed.D., Associate Professor of Education
⁴James David Barber (1972), Ph.D., James B. Duke Professor of Political Science
Richard T. Barber (1970), Ph.D., Associate Professor of Zoology and Associate Professor of Botany
Robert Lloyd Barnes (1965), Ph.D., Professor of Forest Biochemistry
Roger C. Barr (1969), Ph.D., Associate Professor of Biomedical Engineering
Robert Charles Bartlett (1976), M.A., Professor of Physical Therapy
Joseph Battle (1970), Ph.D., Associate Professor of Business Administration
Gilbert Bauman (1976), Dr. Sc., Assistant Medical Research Professor of Physiology
William Waldo Beach (1946), Ph.D., Professor of Christian Ethics
Hie Ping Beall (1975), Ph.D., Assistant Medical Research Professor of Anatomy and Assistant Medical Research Professor of Physiology
Robert D. Behn (1973), Ph.D., Associate Professor of Policy Sciences
Robert M. Bell (1972), Ph.D., Associate Professor of Biochemistry
Peter Brian Bennett (1972), Ph.D., Associate Professor of Physiology
Charles W. Bergquist (1972), Ph.D., Associate Professor of History
William Bevan (1974), Ph.D., William Preston Few Professor of Psychology
L.C. Biedenharn, Jr. (1961), Ph.D., Professor of Physics
Alan Biermann (1974), Ph.D., Associate Professor of Computer Science
Darell D. Bigner (1972), M.D., Ph.D., Associate Professor of Pathology and Lecturer in Microbiology and Immunology
William Dwight Billings (1952), Ph.D., James B. Duke Professor of Botany
Edward George Bilpuch (1962), Ph.D., Professor of Physics
John A. Bittikofer (1970), Ph.D., Associate in Clinical Biochemistry
Thorir D. Bjornsson (1978), M.D., Assistant Professor of Pharmacology
John O. Blackburn (1962), Ph.D., Professor of Economics
Kalman P. Bland (1973), Ph.D., Associate Professor of Religion
Colin C. Blaydon (1975), Ph.D., Associate Professor of Policy Sciences and Business Administration
J. J. Blum (1962), Ph.D., Professor of Physiology
Bruce R. Bolnick (1974), Ph.D., Assistant Professor of Economics
Dani P. Bolognesi (1971), Ph.D., Associate Professor of Virology

¹Sabbatical leave, fall semester, 1978.

²Sabbatical leave, spring semester, 1978.

³Sabbatical leave, fall semester, 1978.

⁴Sabbatical leave, fall semester, 1978.

- Celia Bonaventura (1972), Ph.D., *Assistant Medical Research Professor of Biochemistry*
 Joseph Bonaventura (1972), Ph.D., *Assistant Medical Research Professor of Biochemistry*
⁵Frank Borchardt (1971), Ph.D., *Associate Professor of Germanic Languages and Literature*
 Lloyd J. Borstelmann (1953), Ph.D., *Professor of Psychology*
 Edward H. Bossen (1972), M.D., *Associate Professor of Pathology*
 Patrick A. Boudewyns (1975), Ph.D., *Lecturer in Psychology*
 John E. Boynton (1968), Ph.D., *Professor of Botany*
 William D. Bradford (1966), M.D., *Associate Professor of Pathology*
 David G. Bradley (1949), Ph.D., *Professor of Religion*
 Charles Kilgo Bradsher (1939), Ph.D., *James B. Duke Professor of Chemistry*
 Ralph Braibanti (1953), Ph.D., *James B. Duke Professor of Political Science*
 Eleanor F. Branch (1972), Ph.D., *Associate Professor of Physical Therapy*
 Alexandre Brandwajn (1978), Ph.D., *Associate Professor of Computer Science*
 Arnold Ralph Brody (1978), Ph.D., *Adjunct Professor of Pathology*
⁶Martin Bronfenbrenner (1971), Ph.D., *William R. Kenan, Jr. Professor of Economics and Lecturer in History*
 Earl Ivan Brown II (1960), Ph.D., *J. A. Jones Professor of Civil Engineering*
 Montague Brown (1975), D.P.H., *Professor of Health Administration*
 C. Edward Buckley III (1963), M.D., *Assistant Professor of Microbiology and Immunology*
 Rebecca Buckley (1968), M.D., *Associate Professor of Immunology*
 Louis J. Budd (1952), Ph.D., *Professor of English*
 Donald S. Burdick (1962), Ph.D., *Associate Professor of Mathematics and Associate Professor of Biomedical Engineering*
 Peter C. Burger (1973), M.D., *Associate Professor of Pathology*
 Peter H. Burian (1968), Ph.D., *Associate Professor of Classical Studies*
⁷R. O. Burns (1964), Ph.D., *Professor of Microbiology*
 Richard M. Burton (1970), D.B.A., *Associate Professor of Business Administration*
 Ronald Richard Butters (1967), Ph.D., *Associate Professor of English*
 Gale H. Buzzard (1957), Ph.D., *Assistant Professor of Mechanical Engineering*
 Edwin H. Cady (1973), Ph.D., *Andrew W. Mellon Professor in the Humanities*
 John Clifford Cambier (1978), Ph.D., *Assistant Medical Research Professor of Immunology*
 Richard T. Campbell (1974), Ph.D., *Assistant Professor of Sociology*
 Marjory A. Cannon (1976), M.M.S., *Associate in Physical Therapy*
 Nell Cant (1978), Ph.D., *Assistant Professor of Anatomy*
 Peter F. Carbone (1966), Ed.D., *Associate Professor of Education*
 Robert C. Carson (1960), Ph.D., *Professor of Psychology*
 Reginald D. Carter (1971), Ph.D., *Adjunct Assistant Professor of Physiology*
 Matt Cartmill (1969), Ph.D., *Associate Professor of Anatomy and Associate Professor of Anthropology*
 William H. Cartwright (1951), Ph.D., *Professor of Education*
 Ernesto Caserta (1970), Ph.D., *Assistant Professor of Romance Languages*
 John H. Casseday (1972), Ph.D., *Assistant Professor of Psychology*
 John Cell (1962), Ph.D., *Associate Professor of History*
 Jack B. Chaddock (1966), Sc.D., *Professor of Mechanical Engineering*
 William Chafe (1971), Ph.D., *Associate Professor of History*
 Jagdish Chandra (1974), Ph.D., *Adjunct Associate Professor of Mathematics*
 James H. Charlesworth (1969), Ph.D., *Associate Professor of Religion*
⁸Donald B. Chesnut (1965), Ph.D., *Professor of Chemistry*
 Norman L. Christensen, Jr. (1973), Ph.D., *Assistant Professor of Botany*
 Howard G. Clark (1968), Ph.D., *Professor of Biomedical Engineering and Materials Science*
 Frederic N. Cleaveland (1971), Ph.D., *Professor of Political Science*
 Franklin H. Cocks (1972), Sc.D., *Professor of Materials Science*
 Kalman J. Cohen (1974), Ph.D., *Distinguished Bank Research Professor and Professor of Business Administration*
 John D. Coie (1968), Ph.D., *Associate Professor of Psychology*
 Jeffrey J. Collins (1974), Ph.D., *Assistant Professor of Microbiology*
 Joel Colton (1947), Ph.D., *Professor of History*
 Robert Merle Colver (1953), Ed.D., *Associate Professor of Education*
 P. Michael Conn (1978), Ph.D., *Assistant Professor of Pharmacology*
 Robert Franklin Conrad (1978), Ph.D., *Assistant Professor of Economics*
 Frank J. Convery (1971), Ph.D., *Associate Professor of Forest Resource Economics*
 Philip J. Cook (1973), Ph.D., *Assistant Professor of Policy Sciences and Economics*
 Thomas Howard Cordle (1950), Ph.D., *Professor of Romance Languages*
 Joseph M. Corless (1972), M.D., Ph.D., *Assistant Professor of Anatomy*
 Roger J. Corless (1970), Ph.D., *Associate Professor of Religion*

⁵Sabbatical leave academic year, 1978-79

⁶Sabbatical leave, fall semester, 1978 and leave of absence, spring semester, 1979.

⁷Sabbatical leave, 1 September 1978 to 1 March 1979.

⁸Sabbatical leave, spring semester, 1979.

- Ronald B. Corley (1977), Ph.D., Assistant Medical Research Professor of Microbiology and Immunology
Philip Robert Costanzo (1968), Ph.D., Associate Professor of Psychology
Martin Joseph Costello III (1975), Ph.D., Assistant Professor of Anatomy
⁹John D. Costlow, Jr. (1959), Ph.D., Professor of Zoology
¹⁰Sheila J. Counce (1968), Ph.D., Professor of Anatomy
John Crellin (1977), Ph.D., Associate Professor of Community and Family Medicine (Medical History)
Peter Cresswell (1973), Ph.D., Associate Professor of Immunology
Byron P. Croker, Jr. (1977), M.D., Ph.D., Assistant Professor of Pathology
Herbert F. Crovitz (1963), Ph.D., Lecturer in Psychology
Alvin L. Crumbliss (1970), Ph.D., Associate Professor of Chemistry
Chicita F. Culberson (1971), Ph.D., Lecturer and Senior Research Associate in Botany
William Louis Culberson (1955), Ph.D., Professor of Botany
¹¹Robert Earle Cushman (1945), Ph.D., Research Professor of Systematic Theology
¹²Ronald Y. Cusson (1970), Ph.D., Professor of Physics
¹³Charles Daniels (1970), M.D., Ph.D., Associate Professor of Pathology
David G. Davies (1961), Ph.D., Professor of Economics
¹⁴William D. Davies (1966), D.D., F.B.A., George Washington Ivey Professor of Advanced Studies and Research in Christian Origins
Calvin D. Davis (1962), Ph.D., Professor of History
James Norman Davis (1972), M.D., Associate Professor of Pharmacology
Lucy T. Davis (1969), Ed.D., Associate Professor of Education
Jeffrey R. Dawson (1972), Ph.D., Associate Professor of Immunology
Eugene Davis Day (1962), Ph.D., Professor of Immunology and Professor of Chemistry
Ruth S. Day (1978), Ph.D., Associate Professor of Psychology
Peter R. Decker, (1975), Ph.D., Assistant Professor of Policy Sciences and History
Thomas J. Delaney (1974), M.S., Assistant Professor of Health Administration
David C. Dellinger (1968), Ph.D., Associate Professor of Business Administration
¹⁵Frank C. De Lucia (1969), Ph.D., Associate Professor of Physics
¹⁶Neil de Marchi (1971), Ph.D., Associate Professor of Economics
A. Leigh DeNeef (1969), Ph.D., Associate Professor of English
Irving Diamond (1958), Ph.D., James B. Duke Professor of Psychology, Professor of Physiology, and Lecturer in Anatomy
Joseph Di Bona (1967), Ph.D., Associate Professor of Education
Joseph di Corcia (1975), Ph.D., Assistant Professor of History
¹⁷Arif Dirlik (1971), Ph.D., Associate Professor of History
David A. Dittman (1978), Ph.D., Associate Professor of Business Administration
Bernard I. Duffey (1963), Ph.D., Professor of English
¹⁸Kenneth Lindsay Duke (1940), Ph.D., Associate Professor of Anatomy
Robert F. Durden (1952), Ph.D., Professor of History
George F. Dutrow (1976), Ph.D., Adjunct Associate Professor of Forest Economics
George J. Dvorak (1967), Ph.D., Professor of Civil Engineering and Professor of Biomedical Engineering
Mark R. Eaker (1977), Ph.D., Assistant Professor of Business Administration
Elaine Martha Eckel (1974), M.A., Assistant Clinical Professor of Physical Therapy
Carol Eckerman (1972), Ph.D., Assistant Professor of Psychology
Jane G. Elchlepp (1960), M.D., Ph.D., Associate Professor of Pathology
Albert Eldridge (1970), Ph.D., Associate Professor of Political Science
Everett H. Ellinwood, Jr. (1966), M.D., Assistant Professor of Pharmacology
Ernest Elsevier (1950), M.S., Associate Professor of Mechanical Engineering
Sharyn Endow (1978), Ph.D., Assistant Professor of Microbiology
Carl Erickson (1966), Ph.D., Professor of Psychology
Harold P. Erickson (1970), Ph.D., Associate Professor of Anatomy
Robert P. Erickson (1961), Ph.D., Professor of Psychology and Associate Professor of Physiology
Jose A. Espejo (1975), Ph.D., Assistant Professor of Business Administration
Evan A. Evans (1973), Ph.D., Associate Professor of Biomedical Engineering
Lawrence E. Evans (1963), Ph.D., Associate Professor of Physics
Henry A. Fairbank (1962), Ph.D., Professor of Physics

⁹Sabbatical leave, fall semester, 1978.

¹⁰Sabbatical leave, fall semester, 1978.

¹¹Sabbatical leave, spring semester, 1979.

¹²Sabbatical leave, fall semester, 1978.

¹³Sabbatical leave, academic year, 1978-79.

¹⁴Sabbatical leave, fall semester, 1978 and leave of absence, spring semester, 1979.

¹⁵Leave of absence, academic year 1978-79.

¹⁶Sabbatical leave, spring semester, 1979.

¹⁷Leave of absence, academic year, 1978-79.

¹⁸Sabbatical leave, 1 July 1979 to 31 December 1979.

- David J. Falcone (1975), M.H.A., Ph.D., Assistant Professor of Health Administration and Assistant Professor of Political Science
- John Morton Fein (1950), Ph.D., Professor of Romance Languages
- Stefano Fenoaltea (1978), Ph.D., Associate Professor of Economics
- Arthur Bowles Ferguson (1939), Ph.D., Professor of History
- Oliver W. Ferguson (1957), Ph.D., Professor of English
- Bernard F. Fetter (1951), M.D., Professor of Pathology
- ¹⁹Peter G. Fish (1969), Ph.D., Associate Professor of Political Science
- Jon Fjeld (1977), Ph.D., Assistant Professor of Philosophy
- ²⁰Daniel E. Flath (1977), Ph.D., Assistant Professor of Mathematics
- Joel Fleishman (1971), LL.M., Professor of Law
- ²¹Anne Flowers (1972), Ed.D., Professor of Education
- Donald J. Fluke (1958), Ph.D., Professor of Zoology
- John D. Forsyth (1978), D.B.A., Professor of Business Administration
- Lloyd R. Fortney (1964), Ph.D., Associate Professor of Physics
- Richard B. Forward (1971), Ph.D., Associate Professor of Zoology
- Richard G. Fox (1968), Ph.D., Professor of Anthropology
- Donald E. Francisco (1976), Ph.D., Lecturer in Civil Engineering
- Irwin Fridovich (1958), Ph.D., James B. Duke Professor of Biochemistry
- Ernestine Friedl (1973), Ph.D., Professor of Anthropology
- William J. Furbish (1954), M.S., Associate Professor of Geology
- Thomas M. Gallie, Jr. (1954-55; 1956), Ph.D., Professor of Computer Science
- Miguel Garci-Gómez (1973), Ph.D., Associate Professor of Romance Languages
- Donald Eugene Gardner (1976), Ph.D., Adjunct Assistant Professor of Pharmacology
- ²²Devendra P. Garg (1972), Ph.D., Professor of Mechanical Engineering
- ²³Raymond Gavins (1970), Ph.D., Associate Professor of History
- ²⁴Scott Gehman, Jr. (1954), Ph.D., Professor of Psychology in Education
- W. Doyle Gentry (1969), Ph.D., Lecturer in Psychology
- Linda K. George (1976), Ph.D., Associate in Physical Therapy
- Rhett Truesdale George, Jr. (1957), Ph.D., Assistant Professor of Electrical Engineering
- Gerald E. Gerber (1962), Ph.D., Associate Professor of English
- David Geselowitz (1978), Ph.D., Visiting Professor of Biomedical Engineering
- James F. Gifford (1977), Ph.D., Associate Professor of Community and Family Medicine (Medical History)
- Nicholas W. Gillham (1968), Ph.D., Professor of Zoology
- ²⁵Paul B. Ginsburg (1976), Ph.D., Associate Professor of Policy Sciences
- Kenneth E. Glander (1975), Ph.D., Assistant Professor of Anthropology
- Robert F. Gleckner (1978), Ph.D., Professor of English
- Rona Goffen (1978), Ph.D., Assistant Professor of Art
- Martin P. Golding (1976), Ph.D., Professor of Philosophy
- Linda R. Gooding (1974), Ph.D., Assistant Professor of Immunology
- Craufurd Goodwin (1962), Ph.D., James B. Duke Professor of Economics
- Lawrence C. Goodwyn (1971), Ph.D., Associate Professor of History and Senior Research Associate in the Center for Southern Studies
- Walter Gordy (1946), Ph.D., LL.D., D.H.C., James B. Duke Professor of Physics
- Alfred T. Goshaw (1973), Ph.D., Associate Professor of Physics
- Henry G. Grabowski (1972), Ph.D., Professor of Economics
- Teresa Graedon (1975), Ph.D., Adjunct Assistant Professor of Anthropology
- Daniel A. Graham (1969), Ph.D., Professor of Economics
- Doyle G. Graham (1970), M.D., Ph.D., Associate Clinical Professor of Pathology
- Ronald C. Greene (1958), Ph.D., Associate Professor of Biochemistry
- Joseph C. Greenfield (1962), M.D., Associate Professor of Physiology
- John R. Gregg (1957), Ph.D., Professor of Zoology
- Robert C. Gregg (1974), Ph.D., Associate Professor of Patristics and Medieval Church History
- Samson R. Gross (1960), Ph.D., Professor of Genetics and Biochemistry
- Kazimierz Grzybowski (1967), S.J.D., Professor of Political Science
- Walter R. Guild (1960), Ph.D., Professor of Biophysics
- John W. Gutknecht (1969), Ph.D., Associate Professor of Physiology
- Norman Guttman (1951), Ph.D., Professor of Psychology
- Robert L. Habig (1969), Ph.D., Assistant Professor of Clinical Biochemistry

¹⁹Leave of absence, academic year, 1978-79

²⁰Leave of absence, academic year 1978-79.

²¹Sabbatical leave, spring semester, 1979.

²²Sabbatical leave, fall semester, 1978.

²³Sabbatical leave, academic year, 1978-79

²⁴Sabbatical leave, spring semester, 1979

²⁵Leave of absence, academic year 1978-79.

- Donald B. Hackel (1960), M.D., *Professor of Pathology*
 Herbert Hacker, Jr. (1965), Ph.D., *Associate Professor of Electrical Engineering*
 Hugh Marshall Hall, Jr. (1952), Ph.D., *Professor of Political Science*
 William C. Hall (1970), Ph.D., *Associate Professor of Anatomy and Associate Professor of Psychology*
 John Hamilton Hallowell (1942), Ph.D., *James B. Duke Professor of Political Science*
 William E. Hammond (1968), Ph.D., *Assistant Professor of Biomedical Engineering*
 W. Michael Hammond (1976), Ph.D., *Assistant Professor of Anthropology*
 W. Clay Hamner (1977), D.B.A., *Professor of Business Administration*
 Moo-Young Han (1967), Ph.D., *Professor of Physics*
 Philip Handler (1939), Ph.D., *James B. Duke Professor of Biochemistry*
 Detlef Hardorp (1978), Ph.D., *Assistant Professor of Mathematics*
 Charles Morgan Harman (1961), Ph.D., *Professor of Mechanical Engineering*
²⁶Gerald Hartwig (1970), Ph.D., *Professor of History*
 Thomas M. Havrilesky (1969-70; 1971), Ph.D., *Associate Professor of Economics*
 Hal K. Hawkins (1973), M.D., Ph.D., *Assistant Professor of Pathology*
 Willis D. Hawley (1972), Ph.D., *Associate Professor of Policy Sciences and Political Science*
 Milton Heath (1975), LL.B., *Adjunct Professor of Environmental Law*
 Henry Hellmers (1965), Ph.D., *Professor of Botany and Professor of Forestry*
 Robert William Henkens (1968), Ph.D., *Associate Professor of Chemistry*
 Stuart C. Henry (1959), Ph.D., *Professor of American Christianity*
 Duncan Heron (1950), Ph.D., *Professor of Geology*
 Mary Vickers Hershfield (1977), Ph.D., *Assistant Medical Research Professor of Microbiology*
²⁷Frederick Herzog (1960), Th.D., *Professor of Systematic Theology*
 Timothy K. Hight (1977), Ph.D., *Assistant Professor of Mechanical Engineering*
 Robert L. Hill (1961), Ph.D., *James B. Duke Professor of Biochemistry*
 Charles H. Hirschman (1972), Ph.D., *Associate Professor of Sociology*
 Marcus Edwin Hobbs (1935), Ph.D., *University Distinguished Service Professor of Chemistry*
 Robert M. Hochmuth (1978), Ph.D., *Professor of Biomedical Engineering*
 Richard Earl Hodel (1965), Ph.D., *Associate Professor of Mathematics*
 Charles S. Hodges, Jr. (1963), Ph.D., *Adjunct Associate Professor of Forest Pathology*
²⁸Irving B. Holley, Jr. (1947), Ph.D., *Professor of History* B. M. Hollyday (1956), Ph.D., *Professor of History*
 Edward W. Holmes (1974), M.D., *Assistant Professor of Biochemistry*
²⁹Ole R. Holsti (1974), Ph.D., *George V. Allen Professor of Political Science*
 Everett H. Hopkins (1961), M.A., LL.D., *Professor of Education*
 C. Russell Horres, Jr. (1976), Ph.D., *Adjunct Assistant Professor of Physiology*
³⁰Jerry F. Hough (1973), Ph.D., *Professor of Political Science and Policy Sciences*
 Joel C. Huber (1978), Ph.D., *Associate Professor of Business Administration*
 Thomas M. Huber (1978), Ph.D., *Assistant Professor of History*
 John S. Hughes (1976), Ph.D., *Associate Professor of Business Administration*
 Alexander Hull (1962), Ph.D., *Associate Professor of Romance Languages*
 William L. Hylander (1971), Ph.D., *Associate Professor of Anatomy and Associate Professor of Anthropology*
 Robert J. V. Jackson (1977), Ph.D., *Assistant Professor of Mathematics*
³¹Wallace Jackson (1965), Ph.D., *Associate Professor of English*
 B. Jon Jaeger (1972), Ph.D., *Professor of Health Administration*
 Emma Raff Jakoi (1977), Ph.D., *Assistant Professor of Anatomy*
 Harold R. Jantz (1976), Ph.D., *Visiting Professor of Germanic Languages and Literature*
 Benjamin A. Jayne (1976), Ph.D., *Professor of Forestry*
 Peter W. Jeffs (1964), Ph.D., *Professor of Chemistry*
 Marianna Jenkins (1948), Ph.D., *Professor of Art*
 Robert B. Jennings (1975), M.D., *Professor of Pathology*
³²Bronislas de Leval Jezierski (1958), Ph.D., *Associate Professor of Slavic Languages and Literatures*
 Frans F. Jöbssis (1964), Ph.D., *Professor of Physiology*
 Frederick C. Joerg (1947), M.B.A., *Professor of Forest Management*
³³Sheridan Johns III (1970), Ph.D., *Associate Professor of Political Science*
 Charles B. Johnson (1956), Ed.D., *Associate Professor of Education*
 Charles E. Johnson (1976), Ph.D., *Assistant Professor of Mechanical Engineering*
 Edward A. Johnson (1963), M.D., *Professor of Physiology*
 Terry W. Johnson, Jr. (1954), Ph.D., *Professor of Botany*
 William W. Johnston (1963), M.D., *Professor of Pathology*

²⁶Sabbatical leave, academic year, 1978-79.

²⁷Sabbatical leave, fall semester, 1978.

²⁸Leave of absence, academic year, 1978-79.

²⁹Leave of absence, academic year, 1978-79.

³⁰Leave of absence, spring semester, 1978 and academic year, 1978-79.

³¹Sabbatical leave, spring semester, 1979.

³²Sabbatical leave, spring semester, 1979.

³³Sabbatical leave, academic year, 1978-79.

- William Thomas Joines (1966), Ph.D., *Associate Professor of Electrical Engineering*
 Wolfgang Karl Joklik (1968), Ph.D., *James B. Duke Professor of Microbiology and Immunology*
 Buford Jones (1962), Ph.D., *Associate Professor of English*
 Phillip L. Jones (1977), Ph.D., *Assistant Professor of Materials Science*
 Henry Kamin (1948), Ph.D., *Professor of Biochemistry*
 Bernard Kaufman (1968), Ph.D., *Associate Professor of Biochemistry*
 Richard F. Kay (1973), Ph.D., *Associate Professor of Anatomy and Adjunct Associate Professor of Anthropology*
 Thomas F. Keller (1959), Ph.D., *R. J. Reynolds Industries Professor of Business Administration*
³⁴Allen C. Kelley (1972), Ph.D., *Professor of Economics*
 Alan C. Kerckhoff (1958), Ph.D., *Professor of Sociology*
³⁵Robert B. Kerr (1965), Ph.D., *Professor of Electrical Engineering*
 Sung-Hou Kim (1970), Ph.D., *Associate Professor of Biochemistry*
 Gregory A. Kimble (1952-68; 1977), Ph.D., *Professor of Psychology*
 Duncan T. Kinkead (1978), Ph.D., *Assistant Professor of Art*
 Norman Kirshner (1956), Ph.D., *Professor of Pharmacology and Professor of Biochemistry*
 Joseph Weston Kitchen, Jr. (1962), Ph.D., *Associate Professor of Mathematics*
 Gordon K. Klintworth (1964), M.D., Ph.D., *Professor of Pathology*
 Peter H. Klopfer (1958), Ph.D., *Professor of Zoology*
 Kenneth R. Knoerr (1961), Ph.D., *Professor of Forest Meteorology and Associate Professor of Botany*
 Hillel S. Koren (1976), Ph.D., *Assistant Professor of Immunology*
 Allan Kornberg (1965), Ph.D., *Professor of Political Science*
³⁶Wesley A. Kort (1965), Ph.D., *Professor of Religion*
 David Paul Kraines (1970), Ph.D., *Associate Professor of Mathematics*
 Nicholas Michael Kredich (1968), M.D., *Assistant Professor of Biochemistry*
 Irwin Kremen (1963), Ph.D., *Assistant Professor of Psychology*
³⁷Juanita M. Kreps (1955), Ph.D., *James B. Duke Professor of Economics*
 William R. Krigbaum (1952), Ph.D., *James B. Duke Professor of Chemistry*
 Joseph J. Kruzel (1976), Ph.D., *Assistant Professor of Political Science*
 Magnus Jan Krynski (1966), Ph.D., *Professor of Slavic Languages and Literatures*
 Cynthia Moreton Kuhn (1978), Ph.D., *Assistant Professor of Pharmacology*
 David J. Kuhn (1977), Ph.D., *Associate Professor of Education*
³⁸Bruce R. Kuniholm (1977), Ph.D., *Assistant Professor of Policy Sciences and Assistant Professor of History*
 Johannes A. Kylstra (1965), M.D., Ph.D., *Associate Professor of Physiology*
 Leon Lack (1965), Ph.D., *Professor of Pharmacology*
 Creighton Lacy (1953), Ph.D., *Professor of World Christianity*
 Martin Lakin (1958), Ph.D., *Professor of Psychology*
 David J. Lang (1968), M.D., *Associate Professor of Virology*
 David L. Lange (1971), LL.B., *Professor of Policy Sciences*
 Thomas A. Langford (1956), Ph.D., *Professor of Systematic Theology*
 George T. Lathrop (1977), Ph.D., *Lecturer in Civil Engineering*
 Peter K. Lauf (1968), M.D., *Professor of Physiology and Assistant Professor of Immunology*
 Dan Laughhunn (1968-75; 1976), D.B.A., *Professor of Business Administration*
 Bruce B. Lawrence (1971), Ph.D., *Associate Professor of Religion*
 Dewey T. Lawson (1974), Ph.D., *Assistant Professor and Research Associate in Physics*
 Jeffrey David Lazar (1978), M.D., *Assistant Professor of Pharmacology*
 Richard H. Leach (1955), Ph.D., *Professor of Political Science*
 Harold E. Lebovitz (1962), M.D., *Associate Professor of Physiology*
 Robert Lefkowitz (1973), M.D., *Assistant Professor of Biochemistry*
 Jonathan Peter Leis (1974), Ph.D., *Assistant Professor of Virology*
 Warren Lerner (1961), Ph.D., *Professor of History*
 Alan S. Levy (1973), Ph.D., *Assistant Professor of Psychology*
 Harry L. Levy (1975), Ph.D., *Visiting Professor of Classical Studies*
 Nelson Levy (1974), M.D., Ph.D., *Associate Professor of Immunology*
 Roy J. Lewicki (1977), Ph.D., *Associate Professor of Business Administration*
 Arie Y. Lewin (1974), Ph.D., *Professor of Business Administration*
 Carol W. Lewis (1975), Ph.D., *Research Associate in Pathology*
 H. Gregg Lewis (1975), Ph.D., *Professor of Economics*
 Harold Walter Lewis (1946), Ph.D., *Professor of Physics*
 Melvyn Lieberman (1968), Ph.D., *Professor of Physiology*
 C. Eric Lincoln (1976), Ph.D., *Professor of Sociology of Religion*
 Joseph Lipscomb, Jr. (1974), Ph.D., *Assistant Professor of Policy Sciences and Economics*

³⁴Sabbatical leave, academic year, 1978-79

³⁵Sabbatical leave, fall semester, 1978

³⁶Sabbatical leave, fall semester, 1978

³⁷Special leave of absence, effective 20 January 1977, to serve as Secretary of Commerce.

³⁸Leave of absence, 1 January 1979 to 31 December 1979.

- Daniel A. Livingstone (1956), Ph.D., *Professor of Zoology*
 Charles H. Lochmüller (1969), Ph.D., *Associate Professor of Chemistry*
 Gregory Lockhead (1965), Ph.D., *Professor of Psychology*
 Charles Houston Long (1974), Ph.D., *Professor of Religion*
 William Longley (1968), Ph.D., *Associate Professor of Anatomy*
 Donald Loveland (1973), Ph.D., *Professor of Computer Science*
 Peter W. Lucas (1977), Ph.D., *Assistant Professor of Physics*
 William L. Luken, Jr. (1976), Ph.D., *Assistant Professor of Chemistry*
 John G. Lundberg (1970), Ph.D., *Associate Professor of Zoology*
 William S. Lynn, Jr. (1954), M.D., *Associate Professor of Biochemistry*
 George W. Lynts (1965), Ph.D., *Associate Professor of Geology*
 John M. McCann (1978), Ph.D., *Associate Professor of Business Administration*
 Kenneth S. McCarty (1959), Ph.D., *Professor of Biochemistry*
 Kenneth Scott McCarty, Jr. (1976), M.D., Ph.D., *Assistant Professor of Pathology*
 David R. McClay (1973), Ph.D., *Associate Professor of Zoology and Assistant Professor of Immunology*
 John B. McConahay (1974), Ph.D., *Associate Professor of Policy Sciences and Associate Professor of Psychology*
 Barbara P. McCool (1975), Ph.D., *Associate Professor of Health Administration*
 James H. McElhaney (1973), Ph.D., *Professor of Biomedical Engineering*
 Marjorie McElroy (1970), Ph.D., *Associate Professor of Economics*
 Philip A. McHale (1972), Ph.D., *Adjunct Assistant Professor of Physiology*
 Thomas J. McIntosh (1977), Ph.D., *Assistant Professor of Anatomy*
 Margaret A. McKean (1974), Ph.D., *Assistant Professor of Political Science*
 Patrick A. McKee (1969), M.D., *Assistant Professor of Biochemistry*
 John C. McKinney (1957), Ph.D., *Professor of Sociology*
 Thomas J. McManus (1961), M.D., *Associate Professor of Physiology*
 Andrew T. McPhail (1968), Ph.D., *Professor of Chemistry*
 George L. Maddox (1960), Ph.D., *Professor of Sociology*
 Wesley A. Magat (1974), Ph.D., *Assistant Professor of Business Administration*
 Edward P. Mahoney (1965), Ph.D., *Professor of Philosophy*
 Charles S. Maier (1976), Ph.D., *Associate Professor of History*
³⁹Steven F. Maier (1971), Ph.D., *Associate Professor of Business Administration*
 Lazaro J. Mandel (1972), Ph.D., *Associate Professor of Physiology*
 Richard B. Marchase (1978), Ph.D., *Assistant Professor of Anatomy*
 Peter N. Marinos (1968), Ph.D., *Professor of Electrical Engineering and Professor of Computer Science*
 Sidney David Markman (1947), Ph.D., *Professor of Art History and Archaeology*
 Gail R. Marsh (1969), Ph.D., *Lecturer in Psychology*
 David V. Martin (1962), Ed.D., *Associate Professor of Education*
 Seymour Mauskopf (1964), Ph.D., *Associate Professor of History*
 Robert Arthur Maxwell (1970), Ph.D., *Adjunct Professor of Pharmacology*
 George Mayer (1974), Ph.D., *Adjunct Associate Professor of Materials Science*
 Miguel A. Medina, Jr. (1976), Ph.D., *Assistant Professor of Civil Engineering*
⁴⁰Elgin W. Mellow, Jr. (1965), Ph.D., *Associate Professor of English*
 Robert J. Melosh (1978), Ph.D., *Professor of Civil Engineering*
 Lorne Mendell (1968), Ph.D., *Associate Professor of Physiology*
 Nancy Role Mendell (1977), Ph.D., *Assistant Medical Research Professor of Immunology*
 Daniel B. Menzel (1971), Ph.D., *Professor of Pharmacology*
 Mary F. Mericle (1977), Ph.D., *Assistant Professor of Business Administration*
 Louis John Metz (1963), Ph.D., *Adjunct Associate Professor of Forest Soils*
 Richard S. Metzgar (1962), Ph.D., *Professor of Immunology*
 Johannes Horst Max Meyer (1959), Ph.D., *Professor of Physics*
 Eric M. Meyers (1969), Ph.D., *Associate Professor of Religion*
 George Michalopoulos (1977), M.D., Ph.D., *Assistant Professor of Pathology*
 Michael L. Michlin (1977), Ph.D., *Assistant Professor of Education*
⁴¹Martin Miller (1970), Ph.D., *Associate Professor of History*
 Sara Elizabeth Miller (1973), Ph.D., *Assistant Medical Research Professor of Microbiology*
 Elliott Mills (1968), Ph.D., *Associate Professor of Pharmacology and Associate Professor of Physiology*
 Thomas G. Mitchell (1974), Ph.D., *Assistant Professor of Mycology*
 Paul L. Modrich (1976), Ph.D., *Assistant Professor of Biochemistry*
 Gary S. Monroe (1978), Ph.D., *Assistant Professor of Business Administration*
⁴²Gerald Monsman (1965), Ph.D., *Associate Professor of English*
⁴³John W. Moore (1961), Ph.D., *Professor of Physiology*

³⁹Sabbatical leave, spring semester, 1979.

⁴⁰Sabbatical leave, spring semester, 1979.

⁴¹Sabbatical leave, spring semester, 1979 and leave of absence, fall semester, 1979.

⁴²Sabbatical leave, spring semester, 1979.

⁴³Sabbatical leave, 1 November 1978 to 30 April 1979.

- Lawrence C. Moore, Jr. (1966), Ph.D., *Associate Professor of Mathematics*
 Richard C. Morey (1978), Ph.D., *Professor of Management Science*
 Montrose J. Moses (1959), Ph.D., *Professor of Anatomy*
 Bruce J. Muga (1967), Ph.D., *Professor of Civil Engineering*
⁴⁴Roland E. Murphy (1967-68; 1971), S.T.D., *Professor of Old Testament*
 Francis Joseph Murray (1960), Ph.D., *Professor of Mathematics*
 Michael P. Murray (1978), Ph.D., *Associate Professor of Policy Sciences*
⁴⁵George C. Myers (1968), Ph.D., *Professor of Sociology*
 J. Victor Nadler (1978), Ph.D., *Assistant Professor of Pharmacology*
⁴⁶Daniel Nagin (1976), Ph.D., *Assistant Professor of Policy Sciences*
 Donald H. Namm (1974), Ph.D., *Adjunct Assistant Professor of Pharmacology*
 Toshio Narahashi (1962-63; 1965), Ph.D., *Visiting Professor of Pharmacology*
 Sydney Nathans (1966), Ph.D., *Associate Professor of History*
 Aubrey Willard Naylor (1952), Ph.D., *James B. Duke Professor of Botany*
⁴⁷Thomas H. Naylor (1964), Ph.D., *Professor of Economics and Professor of Computer Science*
⁴⁸Francis Newton (1967), Ph.D., *Professor of Latin in Classical Studies*
 Charles Adam Nichol (1970), Ph.D., *Adjunct Professor of Pharmacology*
⁴⁹Robert Bruce Nicklas (1965), Ph.D., *Professor of Zoology*
⁵⁰Robert Niess (1972), Ph.D., *Professor of Romance Languages*
 Frederik Nijhout (1977), Ph.D., *Assistant Professor of Zoology*
 Loren W. Nolte (1966), Ph.D., *Professor of Electrical Engineering and Professor of Biomedical Engineering*
 Yasuhiko Nozaki (1966), Ph.D., *Associate in Biochemistry*
 Holger O. Nygard (1960), Ph.D., *Professor of English*
 John F. Oates (1967), Ph.D., *Professor of Ancient History in Classical Studies*
 William O'Barr (1969), Ph.D., *Associate Professor of Anthropology*
 Fearghus O'Foghludha (1975), Ph.D., *Adjunct Professor of Physics*
 Ronald W. Oppenheim (1973), Ph.D., *Lecturer in Psychology*
 Robert T. Osborn (1954), Ph.D., *Professor of Religion*
 Suydam Osterhout (1959), M.D., Ph.D., *Professor of Microbiology*
 Rafael Osuna (1977), Ph.D., *Professor of Romance Languages*
 Athos Ottolenghi (1959), M.D., *Professor of Pharmacology*
 Bruce M. Owen (1978), Ph.D., *Associate Professor of Business Administration*
 Harry Ashton Owen, Jr. (1951), Ph.D., *Professor of Electrical Engineering*
 George M. Padilla (1965), Ph.D., *Associate Professor of Physiology*
⁵¹David L. Paletz (1967), Ph.D., *Associate Professor of Political Science*
⁵²Aubrey E. Palmer (1944), B.S.C.E., *Associate Professor of Civil Engineering*
 Richard A. Palmer (1966), Ph.D., *Professor of Chemistry*
 Richard G. Palmer (1977), Ph.D., *Assistant Professor of Physics*
 Erdman B. Palmore (1967), Ph.D., *Professor of Sociology*
 William Leslie Pardon (1977), Ph.D., *Assistant Professor of Mathematics*
⁵³Harry B. Partin (1964), Ph.D., *Associate Professor of Religion*
 Merrell Lee Patrick (1964), Ph.D., *Professor of Computer Science*
 John W. Payne (1977), Ph.D., *Associate Professor of Business Administration*
 William Bernard Peach (1951), Ph.D., *Professor of Philosophy*
 George Wilbur Pearsall (1964), Sc.D., *Professor of Materials Science*
 Ronald D. Perkins (1968), Ph.D., *Professor of Geology*
 Patricia R. Pessar (1977), Ph.D., *Assistant Professor of Anthropology*
 David W. Peterson (1973), Ph.D., *Professor of Management Sciences*
 Leland R. Phelps (1961), Ph.D., *Professor of Germanic Languages and Literature*
 Jane Philpott (1951), Ph.D., *Professor of Botany and Professor of Wood Anatomy*
 Orrin Pilkey (1965), Ph.D., *Professor of Geology*
 Theo C. Pilkington (1961), Ph.D., *Professor of Biomedical Engineering and Professor of Electrical Engineering*
 Colin G. Pitt (1969), Ph.D., *Adjunct Associate Professor of Chemistry*
 Robert A. Pittillo, Jr. (1968), Ed.D., *Associate Professor of Education*
 Salvatore V. Pizzo (1976), M.D., Ph.D., *Assistant Professor of Pathology and Assistant Professor of Biochemistry*
 Jacques C. Poirier (1955), Ph.D., *Professor of Chemistry*
 Ned Allen Porter (1969), Ph.D., *Associate Professor of Chemistry*

⁴⁴Leave of absence, spring semester, 1979.

⁴⁵Sabbatical leave, academic year, 1978-79.

⁴⁶Leave of absence, academic year, 1978-79.

⁴⁷Sabbatical leave, spring semester, 1979.

⁴⁸Sabbatical leave, academic year, 1978-79.

⁴⁹Sabbatical leave, fall semester, 1978.

⁵⁰Sabbatical leave, spring semester, 1979.

⁵¹Leave of absence, academic year, 1978-79.

⁵²Sabbatical leave, spring semester, 1978.

⁵³Sabbatical leave, spring semester, 1979.

- Alejandro Portes (1975), Ph.D., *Professor of Sociology*
 William H. Poteat (1960), Ph.D., *Professor of Religion and Comparative Studies*
 Philip Pratt (1966), M.D., *Professor of Pathology*
 Jack J. Preiss (1959), Ph.D., *Professor of Sociology*
 Richard A. Preston (1965), Ph.D., *William K. Boyd Professor of History*
 David Eugene Price (1973), Ph.D., *Associate Professor of Political Science and Policy Sciences*
 James Ligon Price, Jr. (1952), Ph.D., *Professor of Religion*
⁵⁴Louis DuBose Quin (1957), Ph.D., *Professor of Chemistry*
 Naomi Quinn (1972), Ph.D., *Associate Professor of Anthropology*
 Jill Raitt (1973), Ph.D., *Associate Professor of Historical Theology*
 R. Rajagopal (1974), Ph.D., *Assistant Professor of Quantitative Science*
 K. V. Rajagopalan (1966), Ph.D., *Professor of Biochemistry*
 Charles William Ralston (1954), Ph.D., *Professor of Forest Soils*
 Fidel Ramón (1974), Ph.D., *Assistant Professor of Physiology*
 Joseph S. Ramus (1978), Ph.D., *Assistant Professor of Botany*
 Dale B. J. Randall (1957), Ph.D., *Professor of English*
 Mark D. Rausher (1978), Ph.D., *Assistant Professor of Zoology*
 William M. Reddy (1977), Ph.D., *Visiting Assistant Professor of History*
 Michael Charles Reed (1974), Ph.D., *Professor of Mathematics*
⁵⁵Michael Kay Reedy (1969), M.D., *Associate Professor of Anatomy*
 Keith Arnold Reimer (1975), Ph.D., M.D., *Assistant Professor of Pathology*
⁵⁶Edmund Reiss (1967), Ph.D., *Professor of English*
 Jacqueline A. Reynolds (1969), Ph.D., *Associate Professor of Biochemistry*
⁵⁷Bruce Arie Reznick (1976), Ph.D., *Assistant Professor of Mathematics*
 Willy E. Rice (1974), Ph.D., *Assistant Professor of Sociology*
 John F. Richards (1977), Ph.D., *Associate Professor of History*
 Curtis J. Richardson (1977), Ph.D., *Associate Professor of Resource Ecology*
 David Claude Richardson (1969), Ph.D., *Associate Professor of Biochemistry*
 Lawrence Richardson, Jr. (1966), Ph.D., *James B. Duke Professor of Latin in Classical Studies*
 Kent J. Riggsby (1971), Society of Fellows (Harvard), *Associate Professor of Classical Studies*
 Mary Ellen Riordan (1978), M.S., *Assistant Clinical Professor of Physical Therapy*
 Nathan Russell Roberson (1963), Ph.D., *Professor of Physics*
 George W. Roberts (1971), Ph.D., *Associate Professor of Philosophy*
 Verne Louis Roberts (1973), Ph.D., *Adjunct Professor of Mechanical Engineering*
⁵⁸J. David Robertson (1966), M.D., Ph.D., *James B. Duke Professor of Anatomy*
 George Robinson (1971), Ph.D., *Assistant Professor of Psychology*
 Hugh G. Robinson (1964), Ph.D., *Professor of Physics*
 Herman R. Robl (1959–64; 1966), Ph.D., *Adjunct Professor of Physics*
⁵⁹Ronald L. Rogowski (1975), Ph.D., *Associate Professor of Political Science*
 James L. Rolleston (1975), Ph.D., *Associate Professor of Germanic Languages and Literature*
 Theodore Ropp (1938), Ph.D., *Professor of History*
 Gerald Martin Rosen (1972), Ph.D., *Associate Professor of Pharmacology*
 Donald Karl Rosenberg (1976), Ph.D., *Assistant Professor of Germanic Languages and Literature*
 Bruce R. Rosendahl (1976), Ph.D., *Assistant Professor of Geology*
 Allen D. Roses (1970), M.D., *Assistant Professor of Biochemistry*
 David J. Ross (1972), Ph.D., *Assistant Professor of Philosophy*
 Wendell F. Rosse (1966), M.D., *Professor of Immunology*
 Susan Roth (1973), Ph.D., *Assistant Professor of Psychology*
⁶⁰Donald Francis Roy (1950), Ph.D., *Professor of Sociology*
 David Charles Rubin (1978), Ph.D., *Assistant Professor of Psychology*
 Clyde de Loache Ryals (1973), Ph.D., *Professor of English*
 Harvey J. Sage (1964), Ph.D., *Associate Professor of Biochemistry and Associate Professor of Immunology*
 Edward A. Saibel (1975), Ph.D., *Adjunct Professor of Civil Engineering*
 Lester M. Salamon (1973), Ph.D., *Associate Professor of Political Science and Policy Sciences*
 John V. Salzano (1958), Ph.D., *Professor of Physiology*
 David H. Sanford (1970), Ph.D., *Professor of Philosophy*
⁶¹Lloyd Saville (1946), Ph.D., *Professor of Economics*
 Robert N. Sawyer (1976), Ed.D., *Associate Professor of Education*
 Frederick H. Schachat (1977), Ph.D., *Assistant Professor of Anatomy*

⁵⁴Sabbatical leave, spring semester, 1979.

⁵⁵Sabbatical leave, 1 July 1978 to 30 June 1979.

⁵⁶Sabbatical leave, fall semester, 1978.

⁵⁷Leave of absence, academic year, 1978–79.

⁵⁸Sabbatical leave, 1 October 1978 to 30 September 1979.

⁵⁹Sabbatical leave, spring semester, 1979.

⁶⁰Sabbatical leave, fall semester, 1978.

⁶¹Leave of absence, academic year, 1978–79.

- David G. Schaeffer (1978), Ph.D., *Professor of Mathematics*
 Saul M. Schanberg (1967), M.D., Ph.D., *Professor of Pharmacology*
 Eric Schechter (1978), Ph.D., *Assistant Professor of Mathematics*
⁶²Harold Schiffman (1963), Ph.D., *Professor of Psychology*
 Susan S. Schiffman (1972), Ph.D., *Lecturer in Psychology*
 Knut Schmidt-Nielsen (1952), Mag Sc, Ph.D., *James B. Duke Professor of Physiology in the Department of Zoology*
 David W. Schomberg (1968), Ph.D., *Associate Professor of Physiology*
 James M. Schooler, Jr. (1970), Ph.D., *Adjunct Associate Professor of Physiology*
 Anne Firor Scott (1961), Ph.D., *Professor of History*
 David W. Scott (1971), Ph.D., *Associate Professor of Microbiology and Immunology*
 William E. Scott (1958), Ph.D., *Professor of History*
 Richard A. Scoville (1961), Ph.D., *Associate Professor of Mathematics*
 Richard B. Searles (1965), Ph.D., *Associate Professor of Botany*
 Hillard Foster Seigler (1967), M.D., *Associate Professor of Immunology*
 David G. Shand (1978), Ph.D., M.B., *Professor of Pharmacology*
 Edward J. Shaughnessy, Jr. (1975), Ph.D., *Assistant Professor of Mechanical Engineering*
 Barbara R. Shaw (1975), Ph.D., *Assistant Professor of Chemistry*
 John Shelburne (1973), M.D., Ph.D., *Associate Professor of Pathology*
 Marion L. Shepard (1967), Ph.D., *Associate Professor of Materials Science*
 Joseph R. Shoenfield (1952), Ph.D., *Professor of Mathematics*
 Brij Bhushan Shrivastav (1973), Ph.D., *Assistant Medical Research Professor of Pharmacology*
 James N. Siedow (1976), Ph.D., *Assistant Professor of Botany*
 Lewis M. Siegel (1968), Ph.D., *Associate Professor of Biochemistry*
 Sidney Arthur Simon (1974), Ph.D., *Assistant Professor of Physiology*
 Elwyn L. Simons (1977), D.Phil., *Professor of Anthropology and Professor of Anatomy*
⁶³Ida Harper Simpson (1959), Ph.D., *Associate Professor of Sociology*
 Theodore Alan Slotkin (1971), Ph.D., *Associate Professor of Pharmacology*
⁶⁴Carol A. Smith (1974), Ph.D., *Associate Professor of Anthropology*
 D. Moody Smith (1965), Ph.D., *Professor of New Testament Interpretation*
 David A. Smith (1962), Ph.D., *Associate Professor of Mathematics*
 Donald S. Smith II (1961), M.H.A., *Assistant Professor of Health Administration*
 Grover C. Smith (1952), Ph.D., *Professor of English*
 Harmon L. Smith (1959), Ph.D., *Professor of Moral Theology*
 Joel Smith (1958), Ph.D., *Professor of Sociology*
 Peter Smith (1959), Ph.D., *Professor of Chemistry*
 Ralph E. Smith (1970), Ph.D., *Associate Professor of Microbiology*
 Robert Kent Smith (1975), Ph.D., *Assistant Professor and Research Associate in Physics*
 Ralph Snyderman (1971), M.D., *Associate Professor of Immunology*
 George G. Somjen (1963), M.D., *Professor of Physiology and Lecturer in Psychology*
 Joachim R. Sommer (1957), M.D., *Professor of Pathology*
 Madison S. Spach (1958), M.D., *Professor of Physiology*
 John R. Spencer (1978), Ph.D., *Professor of Art*
 Thomas Arthur Spragens, Jr. (1967), Ph.D., *Associate Professor of Political Science*
 Carol B. Stack (1975), Ph.D., *Associate Professor of Policy Sciences and Adjunct Associate Professor of Anthropology*
 John E. R. Staddon (1967), Ph.D., *Professor of Psychology*
 Gerald R. Stairs (1978), Ph.D., *Professor of Forestry and Environmental Studies*
 William J. Stambaugh (1961), Ph.D., *Professor of Forest Pathology*
 Dennis Keith Stanley (1961), Ph.D., *Associate Professor of Classical Studies*
 Charles Franklin Starmer, Jr. (1966), Ph.D., *Professor of Computer Science*
 Deborah A. Steege (1977), Ph.D., *Assistant Professor of Biochemistry*
 David Curtis Steinmetz (1971), Th.D., *Professor of Church History and Doctrine*
⁶⁵Philip Stewart (1972), Ph.D., *Associate Professor of Romance Languages*
 Alan A. Stone (1975), Ph.D., *Assistant Professor of History*
 Donald E. Stone (1963), Ph.D., *Professor of Botany*
 Kenneth B. Storey (1974), Ph.D., *Assistant Professor of Zoology*
 Boyd R. Strain (1969), Ph.D., *Professor of Botany*
 Victor H. Strandberg (1966), Ph.D., *Associate Professor of English*
 Harold Carl Strauss (1972), M.D., *Assistant Professor of Pharmacology*
 Timothy Lee Strickler (1973), Ph.D., *Assistant Professor of Anatomy*
 Howard Austin Strobel (1948), Ph.D., *Professor of Chemistry*
 Ish Sud (1977), Ph.D., *Adjunct Assistant Professor of Mechanical Engineering*

⁶²Sabbatical leave, spring semester, 1979.

⁶³Sabbatical leave, fall semester, 1978.

⁶⁴Leave of absence, spring semester, 1978.

⁶⁵Sabbatical leave, academic year, 1978-79.

- J. Bolling Sullivan (1970), Ph.D., *Associate Professor of Biochemistry*
 Elizabeth Read Sunderland (1939-42; 1943), Ph.D., *Professor of Art*
 John Sutherland (1969), Ph.D., *Associate Professor of Zoology*
 Louis E. Swanson (1949), A.B., *Associate Professor of Health Administration*
 Charles Tanford (1960), Ph.D., *James B. Duke Professor of Physical Biochemistry*
 George E. Tauchen (1977), Ph.D., *Assistant Professor of Economics*
 Robert Taylor (1974), Ph.D., *Assistant Professor of Business Administration*
 John J. TePaske (1967), Ph.D., *Professor of History*
 Marcel Tetel (1960), Ph.D., *Professor of Romance Languages*
 William Andrew Thompson (1977), Ph.D., *Assistant Professor of Resource Ecology*
 Fredrick L. Thurstone (1967), Ph.D., *Professor of Biomedical Engineering*
⁶⁶Edward A. Tiryakian (1965), Ph.D., *Professor of Sociology*
 Craig Tisher (1969), M.D., *Associate Professor of Pathology*
 Edward Tower (1974), Ph.D., *Professor of Economics*
 Vladimir G. Trembl (1967), Ph.D., *Professor of Economics*
 Kishor S. Trivedi (1975), Ph.D., *Assistant Professor of Computer Science*
 Yuet Tsui (1975), Ph.D., *Assistant Professor of Civil Engineering*
 Vance Tucker (1964), Ph.D., *Professor of Zoology*
 Arlin Turner (1953), Ph.D., *James B. Duke Professor of English*
 Richard L. Tuthill (1953), Ed.D., *Professor of Economic Geography*
 Lee E. Tyrey (1970), Ph.D., *Assistant Professor of Anatomy*
 Senol Utku (1970), Sc.D., *Professor of Civil Engineering*
 Arturo Valenzuela (1970), Ph.D., *Associate Professor of Political Science*
 Thomas C. Vanaman (1970), Ph.D., *Associate Professor of Microbiology and Immunology*
⁶⁷James H. Vander Weide (1972), Ph.D., *Associate Professor of Business Administration*
 J. Michael Vasievich (1977), Ph.D., *Adjunct Assistant Professor of Forest Economics*
 James W. Vaupel (1972), Ph.D., *Assistant Professor of Policy Sciences*
 John M. Vernon (1966), Ph.D., *Professor of Economics*
 Aleksandar Sedmak Vesić (1964), D.Sc., *J. A. Jones Professor of Civil Engineering*
 P. Aarne Vesilind (1970), Ph.D., *Associate Professor of Civil Engineering and Associate Professor of Environmental Studies*
 Elia E. Villanueva (1969), M.A., *Associate Professor of Physical Therapy*
 Patrick R. Vincent (1954), Ph.D., *Associate Professor of Romance Languages*
 Osvaldo Humberto Viveros (1977), M.D., *Adjunct Associate Professor of Pharmacology*
 F. Stephen Vogel (1961), M.D., *Professor of Pathology*
 Steven Vogel (1966), Ph.D., *Associate Professor of Zoology*
 Robin T. Vollmer (1975), M.D., *Assistant Professor of Pathology*
 Olaf T. von Ramm (1974), Ph.D., *Assistant Professor of Biomedical Engineering*
 Fred M. Vukovich (1967), Ph.D., *Adjunct Associate Professor of Forest Meteorology*
 Howard Wachtel (1968), Ph.D., *Associate Professor of Biomedical Engineering and Associate Professor of Physiology*
 Robert A. Wagner (1978), Ph.D., *Associate Professor of Computer Science*
 Stephen A. Wainwright (1964), Ph.D., *Professor of Zoology*
 William D. Walker (1971), Ph.D., *Professor of Physics*
 Andrew G. Wallace (1964), Ph.D., *Assistant Professor of Physiology*
 Thomas Dudley Wallace (1974), Ph.D., *Professor of Economics*
 Lise Wallach (1970), Ph.D., *Lecturer in Psychology*
 Michael Wallach (1962-72; 1973), Ph.D., *Professor of Psychology*
 Richard L. Walter (1962), Ph.D., *Professor of Physics*
 Paul P. Wang (1968), Ph.D., *Professor of Electrical Engineering*
 Calvin L. Ward (1952), Ph.D., *Professor of Zoology*
 Frances Ellen Ward (1969), Ph.D., *Associate Professor of Microbiology and Immunology*
 Bruce W. Wardrop (1962), Ph.D., *William Hanes Wannamaker Professor of Romance Languages*
 D. Michael Warner (1975), M.H.A., Ph.D., *Assistant Professor of Health Administration*
 Seth L. Warner (1955), Ph.D., *Professor of Mathematics*
 David Grant Warren (1975), J.D., *Professor of Health Administration*
 Thomas E. Wartenberg (1977), Ph.D., *Assistant Professor of Philosophy*
 Richard Lyness Watson, Jr. (1939), Ph.D., *Professor of History*
 Katharine Way (1968), Ph.D., *Adjunct Professor of Physics*
 Robert E. Webster (1970), Ph.D., *Professor of Biochemistry*
⁶⁸Eliot Roy Weintraub (1970), Ph.D., *Professor of Economics*
⁶⁹Morris Weisfeld (1967), Ph.D., *Professor of Mathematics*
 Richard L. Wells (1962), Ph.D., *Professor of Chemistry*

⁶⁶Sabbatical leave, academic year, 1978-79.

⁶⁷Sabbatical leave, fall semester, 1978.

⁶⁸Sabbatical leave, fall semester, 1978.

⁶⁹Sabbatical leave, fall semester, 1978.

- Paul Welsh (1948), Ph.D., *Professor of Philosophy*
 Christopher G. Wetzel (1977), Ph.D., *Assistant Professor of Psychology*
⁷⁰John A. Weymark (1977), Ph.D., *Assistant Professor of Economics*
 Robert W. Wheat (1958), Ph.D., *Professor of Microbiology and Assistant Professor of Biochemistry*
 Richard A. White (1963), Ph.D., *Professor of Botany*
 Henry M. Wilbur (1973), Ph.D., *Associate Professor of Zoology*
 Karl Milton Wilbur (1946), Ph.D., *James B. Duke Professor of Zoology*
 Robert L. Wilbur (1957), Ph.D., *Professor of Botany*
 Pelham Wilder, Jr. (1949), Ph.D., *Professor of Chemistry and Professor of Pharmacology*
 Hilda Pope Willett (1948), Ph.D., *Professor of Bacteriology*
 George W. Williams (1957), Ph.D., *Professor of English*
 Kenny J. Williams (1977), Ph.D., *Professor of English*
 William Hailey Willis (1963), Ph.D., *Professor of Greek in Classical Studies*
 James F. Wilson (1967), Ph.D., *Professor of Civil Engineering*
 John Wilson (1968), Ph.D., *Associate Professor of Sociology*
 Thomas George Wilson (1959), Sc.D., *Professor of Electrical Engineering*
 Timothy D. Wilson (1977), Ph.D., *Assistant Professor of Psychology*
 Wilkie Andrew Wilson, Jr. (1974), Ph.D., *Adjunct Assistant Professor of Pharmacology*
 Cliff W. Wing, Jr. (1965), Ph.D., *Professor of Psychology*
 Orval S. Wintermute (1958), Ph.D., *Professor of Religion and Lecturer in Old Testament*
⁷¹Ronald Witt (1971), Ph.D., *Associate Professor of History*
 Benjamin Wittels (1961), M.D., *Professor of Pathology*
 Myron L. Wolbarsht (1968), Ph.D., *Professor of Biomedical Engineering, Associate Professor of Physiology, and Lecturer in Psychology*
 Robert L. Wolpert (1976), Ph.D., *Assistant Professor of Mathematics*
 Peter H. Wood (1975), Ph.D., *Associate Professor of History*
 Max A. Woodbury (1966), Ph.D., *Professor of Computer Science*
⁷²Donald Wright (1967), Ph.D., *Associate Professor of Mechanical Engineering*
 David O. Yandle (1967), Ph.D., *Associate Professor of Forest Mathematics*
 William P. Yohe (1958), Ph.D., *Professor of Economics*
 Charles R. Young (1954), Ph.D., *Professor of History*
 Franklin W. Young (1944-50; 1968), Ph.D., *Amos Ragan Kearns Professor of New Testament and Patristic Studies*
 John G. Younger (1974), Ph.D., *Assistant Professor of Classical Studies*
 Peter Zwadyk, Jr. (1971), Ph.D., *Associate Professor of Pathology and Associate Professor of Microbiology*

Emeritus Professors

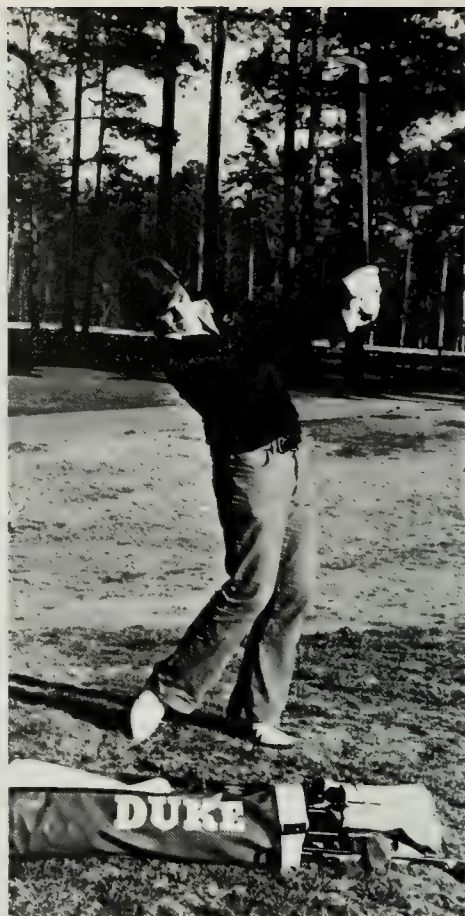
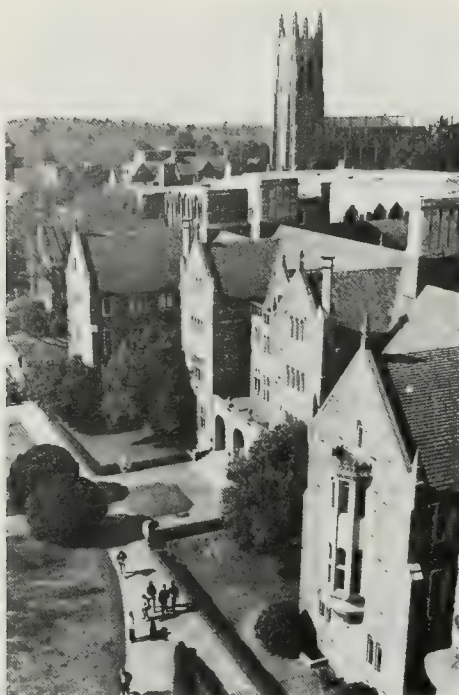
- Francis Dorothy Acomb (1945), Ph.D., *Professor Emeritus of History*
 John Richard Alden (1955), Ph.D., *James B. Duke Professor Emeritus of History*
 M. Margaret Ball (1963), Ph.D., *Professor Emeritus of Political Science*
 Katharine May Banham (1946), Ph.D., *Associate Professor Emeritus of Psychology*
 Joseph W. Beard (1937), M.D., *James B. Duke Professor Emeritus of Virology*
 Frederick Bernheim (1930), Ph.D., *James B. Duke Professor Emeritus of Pharmacology*
 Mary L. C. Bernheim (1930), Ph.D., *Professor Emeritus of Biochemistry*
 Cazlyn Green Bookhout (1935), Ph.D., *Professor Emeritus of Zoology*
 Francis Ezra Bowman (1945), Ph.D., *Professor Emeritus of English*
 Benjamin Boyce (1950), Ph.D., *James B. Duke Professor Emeritus of English*
 Frances Campbell Brown (1931), Ph.D., *Professor Emeritus of Chemistry*
 Leonard Carlitz (1932), Ph.D., *James B. Duke Professor Emeritus of Mathematics*
 Benjamin Guy Childs (1924), M.A., *Professor Emeritus of Education*
 Kenneth Willis Clark (1931), Ph.D., D.D., *Professor Emeritus of New Testament*
 Robert Taylor Cole (1935), Ph.D., *James B. Duke Research Professor Emeritus of Political Science*
 Norman Francis Conant (1935), Ph.D., *James B. Duke Professor Emeritus of Microbiology*
 John S. Curtiss (1945), Ph.D., *James B. Duke Professor Emeritus of History*
 Bingham Dai (1943), Ph.D., *Professor Emeritus of Psychology*
 Gifford Davis (1930), Ph.D., *Professor Emeritus of Romance Languages*
 Frank Traver de Vyver (1935), Ph.D., *University Distinguished Service Professor Emeritus of Economics*
 Neal Dow (1934), Ph.D., *Professor Emeritus of Romance Languages*
 Francis George Dressel (1929), Ph.D., *Professor Emeritus of Mathematics*
 Howard Easley (1930), Ph.D., *Associate Professor Emeritus of Education*
 William Whitfield Elliott (1925), Ph.D., *Professor Emeritus of Mathematics*
 John Wendell Everett (1932), Ph.D., *Professor Emeritus of Anatomy*

⁷⁰Leave of absence, academic year, 1978-79.

⁷¹Sabbatical leave, academic year, 1978-79

⁷²Sabbatical leave spring semester, 1979

Wallace Fowlie (1964), Ph.D., *James B. Duke Professor Emeritus of Romance Languages*
 Allan H. Gilbert (1920), Ph.D., *Professor Emeritus of English*
 Sherwood Githens (1962), Ph.D., *Professor Emeritus of Education*
 Clarence Gohdes (1930), Ph.D., *James B. Duke Professor Emeritus of English*
 Irving Emery Gray (1930), Ph.D., *Professor Emeritus of Zoology*
 Paul M. Gross (1919), Ph.D., *William Howell Pegram Professor Emeritus of Chemistry*
 Louise Hall (1931), Ph.D., *Professor Emeritus of Architecture*
 Frank A. Hanna (1948), Ph.D., *Professor Emeritus of Economics*
 Jerome S. Harris (1936), M.D., *Professor Emeritus of Biochemistry*
 William S. Heckscher (1966), Ph.D., *Benjamin N. Duke Professor Emeritus of Art*
 Jay Broadus Hubbell (1927), Ph.D., *Professor Emeritus of English*
 Wanda S. Hunter (1947), Ph.D., *Associate Professor Emeritus of Zoology*
 Allan S. Hurlburt (1956), Ph.D., *Professor Emeritus of Education*
 William H. Irving (1936), Ph.D., *Professor Emeritus of English*
 Brady Rimbey Jordan (1927), Ph.D., *Professor Emeritus of Romance Languages*
 Helen L. Kaiser (1943), R.P.T., *Professor Emeritus of Physical Therapy*
 Van Leslie Kenyon, Jr. (1945), M.M.E., *Professor Emeritus of Mechanical Engineering and Materials Science*
 Paul Jackson Kramer (1931), Ph.D., *James B. Duke Professor Emeritus of Botany*
 Wladyslaw W. Kulski (1963), Ph.D., LL.D., *James B. Duke Professor Emeritus of Russian Affairs*
 Weston LaBarre (1946), Ph.D., *James B. Duke Professor Emeritus of Anthropology*
 Charles Earl Landon (1926), Ph.D., *Professor Emeritus of Economics*
 John L. Lievsay (1962), Ph.D., *James B. Duke Professor Emeritus of English*
 L. Sigfred Linderoth, Jr. (1965), M.E., *Professor Emeritus of Mechanical Engineering*
 John Nelson Macduff (1956), M.M.E., *Professor Emeritus of Mechanical Engineering*
 Alan Krebs Manchester (1929), Ph.D., *University Distinguished Service Professor Emeritus of History*
 Glenn Robert Negley (1946), Ph.D., *Professor Emeritus of Philosophy*
 Walter McKinley Nielsen (1925), Ph.D., *James B. Duke Professor Emeritus of Physics*
 James G. Osborne (1961), B.S., *Professor Emeritus of Forest Biometry*
 Harold Talbot Parker (1939), Ph.D., *Professor Emeritus of History*
 Robert Leet Patterson (1945), Ph.D., *Professor Emeritus of Philosophy*
 Lewis Patton (1926), Ph.D., *Professor Emeritus of English*
 Michael I. Pavlov (1960), M.A., *Associate Professor Emeritus of Russian*
 Talmage Lee Peele (1939), M.D., *Professor Emeritus of Anatomy*
 Harold Sanford Perry (1932), Ph.D., *Professor Emeritus of Botany*
 Ray C. Petry (1937), Ph.D., LL.D., *James B. Duke Professor Emeritus of Church History*
 Olan Lee Petty (1952), Ph.D., *Professor Emeritus of Education*
 Richard Lionel Predmore (1950), D.M.L., *Professor Emeritus of Romance Languages*
 Mabel F. Rudisill (1948), Ph.D., *Associate Professor Emeritus of Education*
 Herman Salinger (1955), Ph.D., *Professor Emeritus of Germanic Languages and Comparative Literature*
 Charles Richard Sanders (1937), Ph.D., *Professor Emeritus of English*
 William H. Simpson (1930), Ph.D., *Professor Emeritus of Political Science*
 David Tillerson Smith (1930), M.D., Litt.D., *James B. Duke Professor Emeritus of Microbiology*
 H. Shelton Smith (1931), Ph.D., *James B. Duke Professor Emeritus of American Religious Thought*
 Joseph John Spengler (1934), Ph.D., *James B. Duke Professor Emeritus of Economics*
 William Franklin Stinespring (1936), Ph.D., *Professor Emeritus of Old Testament and Semitics*
 W. A. Stumpf (1948), Ph.D., *Professor Emeritus of Education*
 Edgar Tristram Thompson (1935), Ph.D., *Professor Emeritus of Sociology*
 James Nardin Truesdale (1930), Ph.D., *Professor Emeritus of Greek*
 Warren Chase Vosburgh (1928), Ph.D., *Professor Emeritus of Chemistry*
 Henry Weitz (1950), Ed.D., *Professor Emeritus of Education*
 Bruce A. Wells (1964), M.S.E.E., *Associate Professor Emeritus of Electrical Engineering*
 Robert Hilliard Woody (1929), Ph.D., *Professor Emeritus of History*



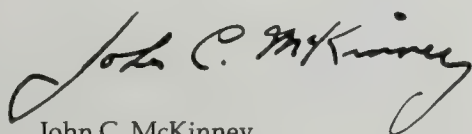
To the Prospective Graduate Student at Duke University

Several years ago a committee of distinguished scholars was appointed and asked to appraise the state of graduate education at Duke University and indicate guidelines for its future development. I would like to quote briefly from the preamble of their report.

The primary role of a university is to provide a focus for the growth of ideas. Since ideas grow in the minds of men, communication between scholars, between faculty and students—in short, teaching—is the first basic function of a university. But without great ideas to communicate—ideas old and new, traditional and nascent—teaching is an exercise of futility. Therefore, the second basic function of a university must be research, characterized by the spirit of free inquiry and the exploration, analysis, and synthesis of ideas. These two faces of a university are complementary.

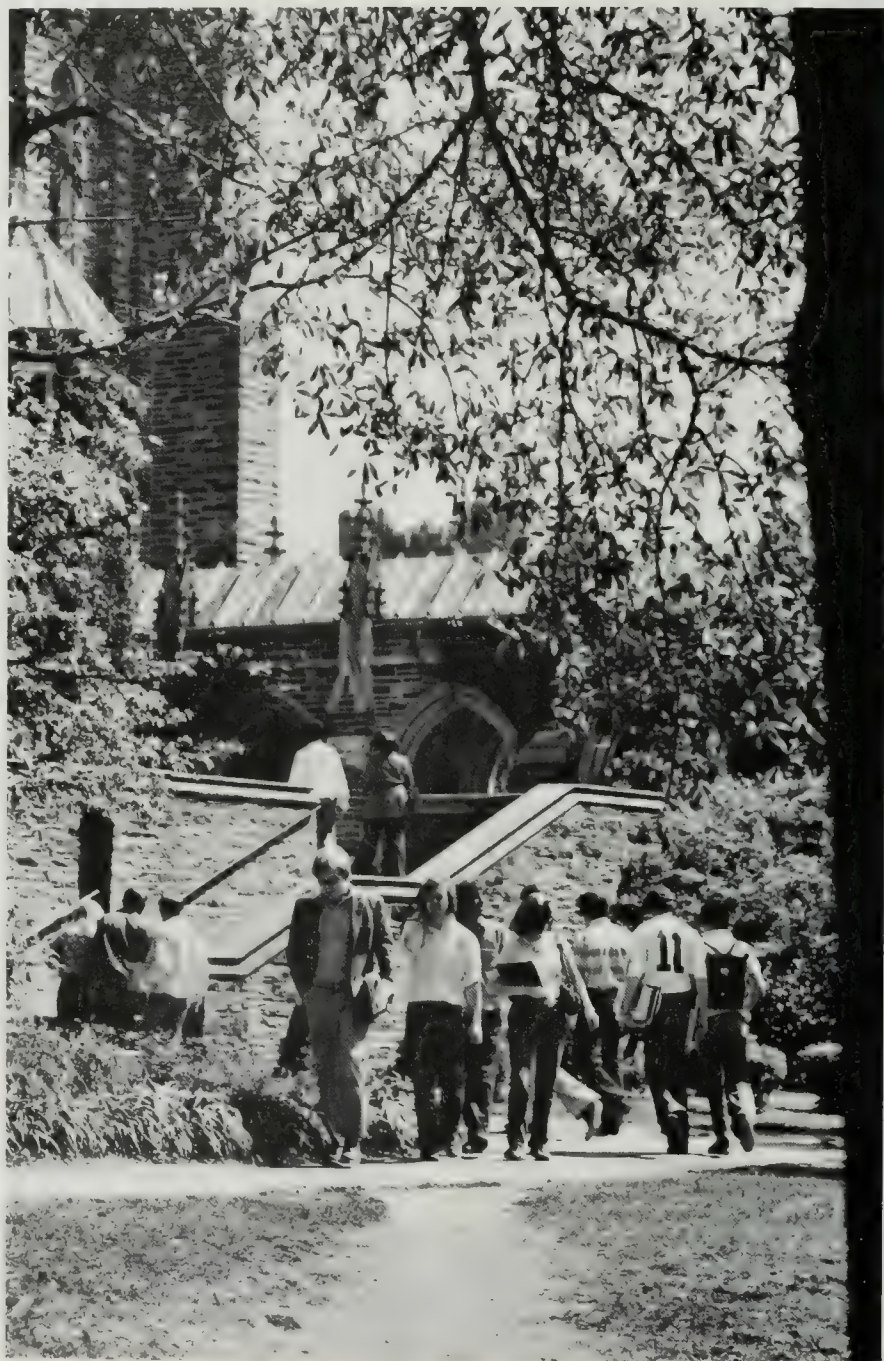
Even in the undergraduate college or in the professional school, the student learns best when moved by a spirit indistinguishable from the mood of the scholar engaged in original research. The ideas taught are, in fact, new to the student and therefore fit material for his “original” research. But it is in the graduate school that teaching and research become truly inseparable.

To the student in search of a superior graduate education Duke University has much to offer: excellent research facilities such as an outstanding library, a major computing center, modern laboratories—but above all, a highly productive graduate faculty dedicated to the twin functions of teaching and research. The following pages, and the information they contain, are addressed to the student seeking a soundly based graduate education.

A handwritten signature in dark ink, reading "John C. McKinney". The signature is fluid and cursive, with a large, sweeping initial "J" and a stylized "M".

John C. McKinney
Dean of the Graduate School

Program Information



Degrees Offered

The Graduate School of Duke University offers the following degrees: Master of Arts (A.M.), Master of Science (M.S.), Master of Education (M.Ed.), Master of Arts in Teaching (M.A.T.), Master of Health Administration (M.H.A.), Doctor of Philosophy (Ph.D.), and Doctor of Education (Ed.D.).

The Master's Degrees

To be considered as a candidate for a master's degree (A.M., M.S., M.Ed., M.A.T., M.H.A.), the graduate student must (1) have made passing grades in the first 12 units of course work, (2) have made a grade of *C* or *E* on at least 3 units of this work, and (3) have received the approval of the major department (or, in the case of the M.A.T. degree, of the supervisory committee).

Residence Requirements. Candidates for all master's degrees must spend, as a *minimum*, one full academic year (two successive semesters), or its equivalent in summer session terms, in residence at Duke University. Candidates who wish to complete their degrees wholly in the summer session must be in residence for a minimum of five summer terms. Additional time is frequently necessary. Three terms are held each summer. (See section on Residence under Academic Regulations.)

Transfer of Graduate Credits. A maximum of 6 units of graduate credit may be transferred for graduate courses completed at other institutions. Such units will be transferred only if the student has received a grade of *B* (or its equivalent) or better. *In any case, the transfer of graduate credit does not reduce the required minimum registration for a master's degree at Duke.* Students who wish to transfer up to 6 units into their programs must register at Duke for units equivalent to the number they are transferring. Requests for transfer should be submitted on the approved Graduate School form (T1).

A student who is granted such transfer credit may be permitted to register for as much as 12 units of thesis research instead of the usual 6 units. As another option, a student may take as many as 6 units of further undergraduate training or 6 units of required language courses on the undergraduate level. In no case will credit be allowed for extension or correspondence courses.

Credit for graduate courses taken at Duke by a student (not undergraduate) before admission to the Graduate School or while registered as a nondegree student may be carried over into a graduate degree program if: (1) the action is

recommended by the student's Director of Graduate Studies and approved by the Dean, (2) the work is not more than two years old, (3) the amount of such credit does not exceed 6 units, and (4) the work is of G level or better.

Time Limits for Completion of Master's Degrees. Master's degree candidates who are in residence for consecutive academic years should complete all requirements for the degree *within two calendar years* from the date of their first registration in the Graduate School. Candidates must complete all requirements *within six calendar years of their first registration*.

To be awarded a degree in May, the student must have completed all requirements, including the recording of transfer credit, by the last day of the final examination period. If a thesis is one of the requirements, it must be submitted to the Graduate School office no later than 15 April. Candidates desiring to have their degrees conferred on 1 September must have completed all requirements, including the recording of transfer of credit, by the final day of the Duke University summer session. Candidates completing degree requirements after that date and during the fall semester will have their degrees conferred on 30 December.

The Thesis. The thesis should demonstrate the student's ability to collect, arrange, interpret, and report pertinent material on a research problem. Although a publishable document is not required, the thesis must be written in an acceptable style and should exhibit the student's competence in scholarly procedures. Requirements of form are set forth in the Duke University *Guide for the Preparation of Theses and Dissertations*, copies of which are available in the Graduate School office.

Recommendation for Teacher Certification. Elementary school teachers who already hold certificates and who desire the recommendation of Duke University for graduate teaching certificates must include in their programs a minimum of 12 units in subjects ordinarily taught in elementary school and 12 units in education courses appropriate to their professional development. Secondary school teachers must include in their programs a minimum of 18 units in their teaching fields and 6 units in courses in education appropriate to their professional development.

MASTER OF ARTS

The Master of Arts degree may be earned either with or without presentation of a thesis. Certain general requirements must be met, however, whether or not the thesis is written.

Prerequisite. As a prerequisite to graduate study in the major subject, a student must have completed a minimum of 24 semester hours—ordinarily 12 semester hours of approved college courses in the major subject and 12 additional semester hours in the major or in related work. Since some departments require more than 12 semester hours in the proposed field of study, students should read carefully the special requirements listed by their major departments, described in the chapter on Courses of Instruction in this bulletin. If special master's degree requirements are not specified in this section, a prospective student should write directly to the appropriate Director of Graduate Studies.

Language Requirements. The Graduate School requires no foreign language for the master's degree. Certain departments, however, do have a foreign language requirement for their master's programs. Any such requirement must be satisfied before the master's examination is taken. (See the departmental sections in the chapter on Courses of Instruction and the chapter on Registration and Regulations.)

Major and Related Subjects. The student must present acceptable grades for a minimum of 24 units of graduate courses. Of these, at least 12 units must be in the major subject. A minimum of 6 units must be in a minor subject or in related fields which are approved by the student's major department. The remaining 6 units of the required 24 may be taken in either the major or in related fields approved by the major department and by the Dean of the Graduate School. A maximum of 6 units may be earned either by submission of an approved thesis, or by completing courses or other academic activities approved by the student's department. Thirty units of graduate credit at Duke constitutes minimum enrollment for the Master of Arts degree.

Completing the Program with Thesis. All basic requirements for preparing the thesis are described in the *Guide for the Preparation of Theses and Dissertations*, available in the Graduate School office.

Four typewritten copies of the thesis bound in snap binders, which may be secured through the Graduate School office, must be submitted in an approved form to the Dean of the Graduate School on or before 15 April for a May degree, one week before the final day of the Duke University third summer session for a September degree, one week before the final day of the fall semester for a December degree, and at least one week before the scheduled date of the final examination. The copies then will be distributed by the student to the several members of the examining committee. Two copies for the library and one copy for the adviser will be bound upon payment of \$5.50 per volume. Additional copies may be bound at the \$5.50 per volume rate.

Completing the Program without Thesis. Individual departments decide the options with which a Master of Arts degree may be completed without presentation of a thesis. The student's committee usually outlines the requirements for a degree program after the student has completed at least 9 units of graded course work. Beyond the 24 units required in major or related course work, 6 units may be earned either through course work or through other academic activities approved by the student's department and committee. Such academic exercises might include an additional 3 units of graded course work complemented, for example, by the following: (1) passing an oral examination on a three- to five-page research prospectus, plus a substantial bibliography on a topic within the student's major field, or (2) submission to the committee of two carefully revised term papers, preferably written originally for different instructors and earning a grade of G or higher. In any case, the student's total minimum registration will be for 30 units of graduate credit followed by a final examination.

The Examining Committee and the Examination. The faculty member who directs the student's program recommends an examining committee composed of himself and two other members of the graduate faculty, one of whom usually must be from a department other than the major department. If the student has been permitted to take related work within the major department, the third member may be chosen from within the department. Nominations for membership on this committee are submitted for approval to the Dean of the Graduate School at least one week preceding the final examination.

The committee will conduct the examination and certify the student's success or failure by signing the card provided by the Graduate School office. This card indicates completion of all requirements for the degree. If a thesis is presented, the committee members also sign all copies of the thesis, and the candidate then returns the original, the first two copies, and any other copies which are to be bound to the Graduate School office.

Filing the Intention to Graduate. On or before *1 February* for a May degree, on or before *1 August* for a September degree, or on or before *1 December* for a December degree, and at least one month prior to the final examination, the student must file in the Office of the Graduate School, on the official form, a declaration of intention to graduate. The declaration of intention presents the title of the thesis or specifies alternative academic exercises on which the degree candidate will be examined. The declaration must have the approval of both the Director of Graduate Studies in the major department and the Chairman of the student's Advisory Committee.

MASTER OF SCIENCE

The degree of Master of Science is offered in various areas, including the following: botany, forestry, geology, pathology, physical therapy, statistics, and computing, and four fields of engineering—biomedical, civil, electrical, and mechanical.

Prerequisite. A bachelor's degree is a prerequisite for the M.S. degree. Departments offering an M.S. degree consider for admission students from allied fields provided they have satisfactory scientific and mathematical backgrounds.

Language Requirement. There is no foreign language requirement in Master of Science degree programs.

Other Degree Requirements. Specific requirements vary according to the department. Please consult the chapter on Courses of Instruction for departmental information concerning prerequisites, minimum units required, and major and related work.

Thesis and Examination. Some departments require a thesis; all departments require an examination. The regulations and options for theses and other means of completing the program, as well as the provisions for examination and the examining committee, are the same as the requirements for the Master of Arts degree discussed in the previous section.

MASTER OF EDUCATION

Prerequisite. The M.Ed. degree is designed for persons intending to pursue a career in professional education. No specific undergraduate major is required for acceptance into a graduate program leading to this degree, but a bachelor's degree in an undergraduate program related to the student's professional goals is required.

Before the degree is conferred, a student must have completed one year of experience in professional education; or have completed 6 units of practicum, internship, and/or field experience; or have met certification requirements by supervised student teaching in an accredited school.

Major and Related Subjects. The student must present acceptable grades for a minimum of 24 units of graduate courses. Of these, at least 12 units must be in a departmental major (administration, supervision, counseling, elementary education, secondary education, reading, teaching the emotionally disturbed, learning disabilities, or other approved programs offered by the department). A minimum of 6 units must be in a minor subject or in related areas within the Department of Education. The remaining 6 units of the required 24 may be taken in either the major or in related subjects. The nature of the additional 6 units for which students must register depends on whether they are enrolled in thesis or nonthesis programs; i.e., the additional 6 units may be earned either by submitting an acceptable thesis or by completing courses in major and related subjects. A minimum of 30 units of earned credit is required for the degree.

Completing the Program with Thesis. The regulations governing the thesis are the same as those for the A.M. degree.

Completing the Program without Thesis. A student must pass a comprehensive examination in the departmental major no sooner than the end of the term in which course work is completed. The examination shall be prepared and conducted by members of the faculty as designated by the Director of Graduate Studies of the Department of Education.

MASTER OF ARTS IN TEACHING

Prerequisites. The M.A.T. degree is designed for teachers already in service and for recent graduates of liberal arts colleges who wish to teach in a public school, private school, or junior college.

Students ordinarily should have completed a minimum of 12 semester hours in their proposed major subjects and an additional 12 semester hours in related subjects. Should a student wish to undertake a graduate major different from the undergraduate major, the prerequisites may be modified upon the recommendation of the student's committee and the approval of the Dean of the Graduate School.

Degree Programs. Either of the following two programs may be arranged in consultation with the student's committee:

1. A student seeking certification must have a major of 18 to 24 units in education and 12 to 18 units in noneducation courses, for a total of 36 units. A maximum of 6 of the 36 units required under this option may be 100-level or undergraduate education courses. A grade of *B* or better must be earned in any undergraduate course included in the 36-unit requirement.
2. A student who is already certified must have a major in noneducation courses of 18 to 24 units and 6 to 12 units in education, for a total of 30 units.

The noneducation courses are to be taken in one or more subjects usually taught in the secondary schools. The quantity and departmental distribution of this work will be determined by the needs of the individual student. A combined major in biological sciences or in physical sciences is possible in this program. Teachers who have already completed certification requirements must major in a



teaching field in their Master of Arts in Teaching program. Students who have not completed certification requirements must major in education.

The Master of Arts in Teaching degree may be earned with or without the presentation of a thesis. If a student, in consultation with the thesis committee, elects to present a thesis, 6 units of the total of 30 or 36 units required may be granted for thesis research. The regulations governing the thesis are the same as those for the A.M. degree *with thesis*.

The Committee. Each candidate for the degree will be assigned a committee, appointed by the Director of Graduate Studies in the major department or area. This committee will consist of three members, at least one of whom will be from the Department of Education, and at least one from another department. Usually the Chairman of the committee will be chosen from the department of the major.

MASTER OF HEALTH ADMINISTRATION

The Department of Health Administration offers a curriculum for graduate students interested in the field of health services management. It is designed primarily for students who hope to assume major leadership roles in a variety of organizations and programs that involve the provision of health services in public or private settings.

The Master of Health Administration program is designed around a core of courses in health services and management sciences, with electives in behavioral sciences. The student selects one of four concentrations for in-depth study: finance, personnel, planning, or information management. The academic program is five semesters in length. Upon completing the degree, the student usually undertakes a twelve-month rotating residency during which a salary is received. (Students with prior experience may petition for a waiver of the residency.)

Students with any undergraduate major may apply. One year of calculus at the college level is the only prerequisite, and a special course is available each summer for students whose preparation in mathematics is inadequate or out of date.

The Doctoral Degrees

Transfer of Credit. Up to 30 units of graduate credit in which a grade of G (or its equivalent) or better was earned may be accepted by transfer only after the student has earned at least 12 units of graduate credit at Duke. Such transfer credit must be on the recommendation of the Chairman of the student's Advisory Committee and the Director of Graduate Studies of the student's major department. (Graduate School form T1 should be used to request transfer of credit.)

Credit for graduate courses taken at Duke by a student (not undergraduate) before admission to the Graduate School or while registered as a nondegree student may be carried over into a graduate degree program if: (1) the action is recommended by the student's Director of Graduate Studies and approved by the Dean, (2) the work is not more than two years old, (3) the amount of such credit does not exceed 6 units, and (4) the work is of G level or better.

DOCTOR OF PHILOSOPHY

The Ph.D. degree is a research degree. Although course work is a necessary part of the student's program, the mere accumulation of course credits will not be sufficient for attaining this degree. The granting of the Ph.D. degree is based primarily upon the student's knowledge of a specialized field of study and upon the production of an acceptable dissertation embodying the results of original research.

Requirements. The formal requirements for the Ph.D. degree are as follows: (1) major and related courses, (2) foreign language(s) in many departments, (3) a supervisory committee for program of study, (4) residence, (5) preliminary examination, (6) dissertation, and (7) final examination. In order to be considered for candidacy for the Ph.D. degree, the student must have passing grades in all course work and a grade of G or better on at least 9 units of this course work.

Foreign Languages. The language requirements for the Doctor of Philosophy degree vary among departments. Some departments do not require a language; some require two languages; and others require a specific language. A prospective student should request information from the appropriate Director of Graduate Studies if no such requirement is described under the departmental heading in this bulletin. (For methods of meeting the requirement, see Language Requirements in the chapter on Registration and Regulations.)

Students working toward the doctoral degree should complete any language requirements set by their departments by the end of their first year of residence. Those who fail to meet the requirement by the end of their third semester of residence should register in the appropriate special reading course or courses which are not applied toward degree credit. Any foreign language requirement must be met before the preliminary examination is taken.

Major and Related Work. The student's program of study demands substantial concentration on courses in the major department. However, a minimum of 6 units in a related field approved by the major department must be included. A few programs have been authorized by the Executive Committee of the Graduate Faculty to utilize courses in fields within the major department in fulfilling the related field requirement.

Committee to Supervise the Program of Study. As early in a student's course of study as is practicable and *not later than two months before the preliminary examination*, the Director of Graduate Studies in the major department will nominate for the approval of the Dean a Supervising Committee consisting of five members, with one member designated as Chairman. This committee will include at least three graduate faculty members of the major department and, usually, at least one from outside the department. For programs in which approval has been granted for related work from a clearly differentiated division within the department, one member of the committee will be chosen from that division. In this circumstance all members of the Supervisory Committee will be from the same department. This committee, with all members participating, will determine a program of study and administer the preliminary examination. The preliminary examination must be administered by all five members of the student's committee. Successful completion of the preliminary examination and the final dissertation examination requires four affirmative votes. The final examination may be administered by four members, if the representative of the related field is present.

Residence. The *minimum* registration requirement is 60 units of graduate credit, of which not more than 30 units may be accepted by transfer. Since a full program is 30 units per academic year, prospective Ph.D. candidates who enter with the A.B. or B.S. degree must plan to spend in residence a *minimum* of two academic years; if they enter with the A.M. degree, their *minimum* residence is one academic year. (For the definition of *residence*, see the section on Academic Regulations.) All students must register for a full program until they pass the preliminary examination. If there are undergraduate deficiencies in their programs, they may be required to take undergraduate courses for which they will not receive degree credit. Even if there are no such undergraduate deficiencies, the

student's Supervisory Committee will determine what requirements above the minimum, if any, the student must meet.

Credit for Summer Work. Credit earned in the summer session will not reduce the minimum required residence. (See the chapter on Study in the Summer.)

Time Limitations. Courses, language certifications, or other credits for advanced standing which are more than six calendar years old at the time that the preliminary examination is passed will not be accepted toward fulfilling the minimum requirements of the doctoral degree.

Ordinarily a student should pass the preliminary examination by the end of the third year of graduate study. A student who has not passed the examination by the end of the third year of full-time registration must file with the Dean of the Graduate School a statement, approved by the Director of Graduate Studies in the major department, explaining the delay and setting a date for the examination. Except under unusual circumstances, extension will not be granted beyond the middle of the fourth year.

The doctoral dissertation should be submitted and accepted within two calendar years after the preliminary examination is passed. Should the dissertation not be submitted and accepted within four years after the examination, the candidate, with the approval of the committee, may petition the Dean of the Graduate School for an extension of up to one year. If this extension is granted and the dissertation is not submitted and accepted by the new deadline, the student will be dropped from candidacy. The student must then pass a second preliminary examination to be reinstated as a candidate for the degree. In such cases, the time limit for submitting the dissertation will be determined by the Dean of the Graduate School and the candidate's committee.

In cases of particular merit, the Dean of the Graduate School may extend the limits of the total elapsed time within which credit will be allowed for courses, the language examination, and the preliminary examination. The graduate faculty of the departments will have these limits in mind when a student is considered for admission or readmission to the Ph.D. program, for approval to take the preliminary examination, and for approval to submit the dissertation and take the final examination. In instances of excessive elapsed time, revalidation of credit may be required. Responsibility for requiring such revalidation rests with the department. Proposed requirements for revalidation require the approval of the Dean of the Graduate School.

Preliminary Examination. A student is not accepted as a candidate for the Ph.D. degree until the preliminary examination has been passed at Duke. The examination ordinarily covers both the major field and related work. In the summer a preliminary examination may be scheduled only between the opening and closing dates of the summer session.

Privilege of Re-examination. A student who fails the preliminary examination may apply, with the consent of the Supervisory Committee and the Dean of the Graduate School, for the privilege of a second examination to be taken no earlier than three months after the date of the first. Successful completion of the second examination requires the affirmative vote of all committee members. Failure on the second examination will render a student ineligible to continue a program for the Ph.D. degree at Duke University.

Reduction in Registration. A student who passes the preliminary examination during the first five weeks of each semester is eligible for a reduction in required registration and should arrange with the Graduate School office the desired changes in registration.

The Dissertation. The dissertation is expected to be a mature and competent piece of writing, embodying the results of significant and original research.

One month before the dissertation is presented and no later than 1 February preceding the May commencement, 1 August for a September degree, and 1 December for a December degree, the student must file with the Dean of the Graduate School, on the official form available in the Graduate School office, the title of the dissertation. This title must receive the written approval of both the Director of Graduate Studies of the student's major department and the professor who directs the dissertation.

The basic requirements for preparing the dissertation (type of paper, form, and binding) are prescribed in the *Guide for the Preparation of Theses and Dissertations*, copies of which are available in the Graduate School office.

The dissertation must be completed to the satisfaction of the professor who directs the dissertation, members of the student's Advisory Committee, and the Dean of the Graduate School. Four typewritten copies, bound in snap binders which may be secured through the Graduate School office, must be submitted to the Dean of the Graduate School on or before 1 April preceding the May commencement, one week before the end of the Duke summer session for a September degree, or one week before the end of the fall semester for a December degree. The dissertation must be submitted to the Graduate School office at least seven days before the scheduled date of the student's examination.

All doctoral dissertations are published on microfilm through Xerox University Microfilms, Ann Arbor, Michigan. Authors may copyright them if they wish. Abstracts are published in *Dissertation Abstracts International*.

In brief, all copies of the dissertation, the original in clean type, will remain in snap binders until after the final examination. Three extra copies of the abstract (not more than 600 words long) are submitted when the dissertation is first presented to the Graduate School office. A nonrefundable fee of \$30 is charged for microfilming. If copyright is desired, an additional fee of \$20 is charged. The original and two copies will be bound at a cost of \$5.50 per volume. The student may request that more than three copies be so bound. A deposit of \$4 is collected for each snap binder on loan from the library used for dissertation copies that will not be bound.

Final Examination. The final oral examination shall be primarily on the dissertation; however, questions may be asked in the candidate's major field. Except in unusual circumstances approved by the Dean, a final examination will be scheduled when school is in session.

A student who fails the final examination may be allowed to take it a second time, but no earlier than six months from the date of the first examination. Permission to take the second examination must be obtained from the professor who directed the dissertation and from the Dean of the Graduate School. Failure to pass the second examination renders the student ineligible to continue work for the Ph.D. degree at Duke University.

Deposit of the Dissertation. After passing the examination, candidates bring to the Graduate School office the original and the first two copies of the dissertation, properly signed, as well as other copies they wish bound. At this time they sign the microfilming agreement and pay microfilming and copyright fees.

DOCTOR OF EDUCATION

The Ed.D. degree is a professional degree for those who are, or intend to become, high-level professional personnel in the field of education. A student will choose one of the following as the area of concentration: (a) administration, (b) supervision, (c) counseling psychology, (d) curriculum and instruction, (e) education of the emotionally disturbed, (f) higher education, (g) reading, (h) school psychology, or (i) learning disabilities.

To be considered as a candidate for the Ed.D. degree, the student must have earned passing grades in the first 30 units of course work at Duke and a grade of G or better on 24 units of this course work.

Major and Related Work. The minimum registration requirement is 60 units of graduate credit, of which not more than 18 units may be in research or accepted by transfer. (Transfer credits which are more than six calendar years old at the time that the preliminary examination is passed will not be accepted.) A student's program must include at least 30 units of course work in the area of concentration and 12 units in related areas.

Registration. A student enrolled in the Ed.D. program must be registered for a minimum of 6 units of graduate credit in each academic year beginning with the first registration after admission to the Ed.D. degree program. For purposes of the Ed.D. program, an academic year begins 1 September and continues through the following 31 August.

Once the preliminary examination is passed, two alternatives are open to a student as follows:

1. A student who remains in residence on campus during the fall and spring semesters must register for a minimum of 3 units of graduate credit for residence each semester. This registration entitles the student to all normal student benefits.
2. A student who goes out of residence (away from the University) must register for at least 6 units of graduate credit during each academic year (1 September through 31 August) until all requirements for the degree have been met. This entitles the student to routine faculty consultation and use of facilities. The out-of-residence "Ed.D. Leave" registration is restricted only to those students who have not passed the preliminary examination for the Ed.D. degree.

Committee to Supervise the Program of Study. As early in a student's course of study as is practicable, and not later than two months before the preliminary examination, the Director of Graduate Studies will nominate for the approval of the Dean a Supervisory Committee of five graduate faculty members, with one member designated as Chairman. One or more members must represent the student's minor field. The committee will determine a program of study, administer the preliminary examination and, with such changes as are approved by the Dean, administer the final doctoral examination.

Experience. Prior to receiving the Ed.D. degree, the student must have at least two years of experience in professional education.



The program of study must include a minimum of 6 units in practicum, internship, and/or field experience under the direction of one or more faculty members.

Time Limitations. Students ordinarily should pass the preliminary examination by the end of their sixth year of graduate study at Duke. If they have not passed it by this time, they must file a statement endorsed by the Director of Graduate Studies with the Dean of the Graduate School explaining the delay and setting a date for the examination.

Preliminary Examination. A student is not accepted as a candidate for the Ed.D. degree until the preliminary examination has been passed. The examination covers both the major field and related work and is taken during or shortly after the term in which the approved program of course work is completed.

A student who fails the preliminary examination may apply, with the consent of the Supervisory Committee and the Dean of the Graduate School, for the privilege of a second examination to be taken no earlier than three months after the date of the first. Successful completion of the second examination requires the affirmative vote of all members of the committee. Failure on the second examination will render the student ineligible to continue a program in the Department of Education at Duke University.

Dissertation. The dissertation is expected to be a mature and competent piece of writing which demonstrates the student's ability to collect, arrange, analyze, evaluate, interpret, and report pertinent material in the area of concentration. This may embody the results of applied research in the form of a major project or model (for example; in-service education plans for a school system, computer programs, curriculum guides, instructional materials) or the results of significant and original research.

Procedural regulations governing the Ed.D. dissertation and final examination are identical to those for the Ph.D. degree.

Policy of Nondiscrimination

Duke University does not discriminate on the basis of race, color, national or ethnic origin, handicap, or sex, in the administration of educational policies, admission policies, financial aid, employment, or any other University program or activity. It admits qualified students of any race, color, national or ethnic origin to all the rights, privileges, programs, and activities generally accorded or made available to students.

Special and Cooperative Programs



Center for the Study of Aging and Human Development

The primary aims of the center are to encourage and support basic and applied research on biomedical, behavioral, and social scientific aspects of adult development and aging, to train research investigators for such research, and to develop sources of scientific information which are accessible to interested individuals and governmental agencies.

Although the center does not offer degrees, the varied programs and research laboratories provide a context and resource for undergraduate and graduate students with special interests in adult development and aging. The center does conduct multidisciplinary two-year programs for postdoctoral fellows interested in focused training for independent research on physiological, behavioral, and social scientific aspects of adult development and aging. Through a program of seminars, collaboration with the senior fellows of the center, and independent research, postdoctoral fellows are able to select and concentrate on selected issues of particular interest. Research methods, the development of specific research skills, and an interdisciplinary perspective are stressed. Resources of this all-University program include data from two longitudinal studies, a wide range of archival data of special interest to social scientists, and the center's basic and applied research laboratories. Undergraduate and graduate students of the University are welcome to inquire about participation in all programs at the center.

Access to the faculties of medicine and arts and sciences is facilitated by a tradition of multidisciplinary research and a central location on campus. Inquiries should be addressed to the Director, Duke University Center for the Study of Aging and Human Development, Duke University Medical Center, Box 3003, Durham, North Carolina 27710.

Canadian Studies Program

The Canadian Studies Program was inaugurated in September 1973, with the aid of grants from the William H. Donner Foundation and the Office of Education of the United States Department of Health, Education and Welfare, and is also supported by a grant from the Andrew W. Mellon Foundation. Its purpose is to formalize and expand graduate interest in Canada, to introduce the study of Canadian life and culture at the undergraduate level, and to encourage such study in primary and secondary schools. The program's basic aim is to increase American knowledge and understanding of Canada.

The program awards graduate fellowships and teaching assistantships for the study of Canada by American residents in the Departments of History, Political Science, Sociology, Education, Health Administration, and Economics. Grants of travel aid for field research in Canada are also offered.

The program also sponsors lectures by Canadian specialists and special annual seminars.

Publications arising from research on Canada may be published in the Commonwealth Studies Series.

Inquiries should be addressed to the Director of Canadian Studies, Center for International Studies, 2101 Campus Drive, Duke University, Durham, North Carolina 27706.

Center for Commonwealth and Comparative Studies

The Center for Commonwealth and Comparative Studies was established at Duke University in 1955 and has received financial support from the Carnegie Corporation of New York, the Rockefeller Foundation, and the Ford Foundation.

The principal purpose of the center is to initiate, stimulate, and further academic interest in the Commonwealth in the broad sense of the internal and domestic affairs of the countries which are at present, or have been in the past, members of the Commonwealth in both contemporary and historical perspectives. In addition, it is concerned with the intra-Commonwealth relations of these countries, the organization of the Commonwealth, and in promoting comparative studies in which the Commonwealth or Commonwealth nations play a prominent role.

Each spring the center sponsors a joint seminar for graduate students in economics, history, law, political science, anthropology, and sociology. The objective of this seminar is to encourage a broad approach to developments within the Commonwealth. The center also sponsors lectures at the University by distinguished Commonwealth scholars.

Studies resulting from research sponsored by the center are frequently published by the Duke University Press in the Commonwealth Studies Series, currently numbering forty-five volumes. Inquiries should be addressed to the Director, Center for Commonwealth and Comparative Studies, Duke University, Durham, North Carolina 27706.

Program in Comparative Studies on Southern Asia

The Program in Comparative Studies on Southern Asia was established at Duke University in 1961, and has received fellowship and other support from the United States Office of Education for South Asia Studies since 1963 under the provisions of Title VI of the National Defense Act. The basic purpose of this program is twofold: to facilitate research on the political, historical, economic, and sociocultural development of countries in southern Asia (India, Pakistan, Sri Lanka, Malaysia, and Singapore), and to provide for the systematic training of graduate students in anthropology, economics, education, history, political science, religion, and sociology, with special emphasis on the area.

Graduate students, in addition to meeting the requirements of the departments in which they are enrolled, are expected to take Hindi-Urdu or another major South Asian language, related courses in other departments, and to undertake field research in the preparation of their dissertations.

Predoctoral fellowships under the conditions specified above are made under the NDEA Title VI language fellowships offered by the United States Office of Education. Departmental and other University grants are open to applicants.

Facilitation and support of research activities by members of the Duke University faculty and graduate students are important aspects of the program's activities. Research grants for faculty and students are also available from the American Institute of Indian Studies. Research facilities include those materials received as a result of the University's participation in a library acquisitions program under the terms of Public Law 480.

The program has undertaken the publication of hardcover monographs dealing with the southern Asian region. It also brings visiting Asian scholars to the campus for lectures and symposia, and cosponsors forums and research activities with the Southern Atlantic States Association for Asian and African Studies and the Association of Asian Studies.

Inquiries should be addressed to the Administrative Assistant, Program in Comparative Studies on Southern Asia, Duke University, Durham, North Carolina 27706.

Cooperative Program in Teacher Education

Program in Secondary Education for the M.A.T. Degree. Selected graduates of liberal arts colleges who have not completed a teacher preparation program will be admitted to the Cooperative Program in Teacher Education to complete their requirements for a teacher's certificate and to pursue additional training in the proposed teaching field. Full-year internships with salary are arranged with cooperating public and private school systems. Students admitted to this program are required to attend the Duke summer school before their year of teaching internship. This program is designed for students preparing to teach science, English, mathematics, or social studies in junior and senior high schools. For materials describing this program, write to the Graduate School, 127 Allen Building, or to the Director, Cooperative Program in Teacher Education, Department of Education, West Duke Building, Durham, North Carolina 27708.

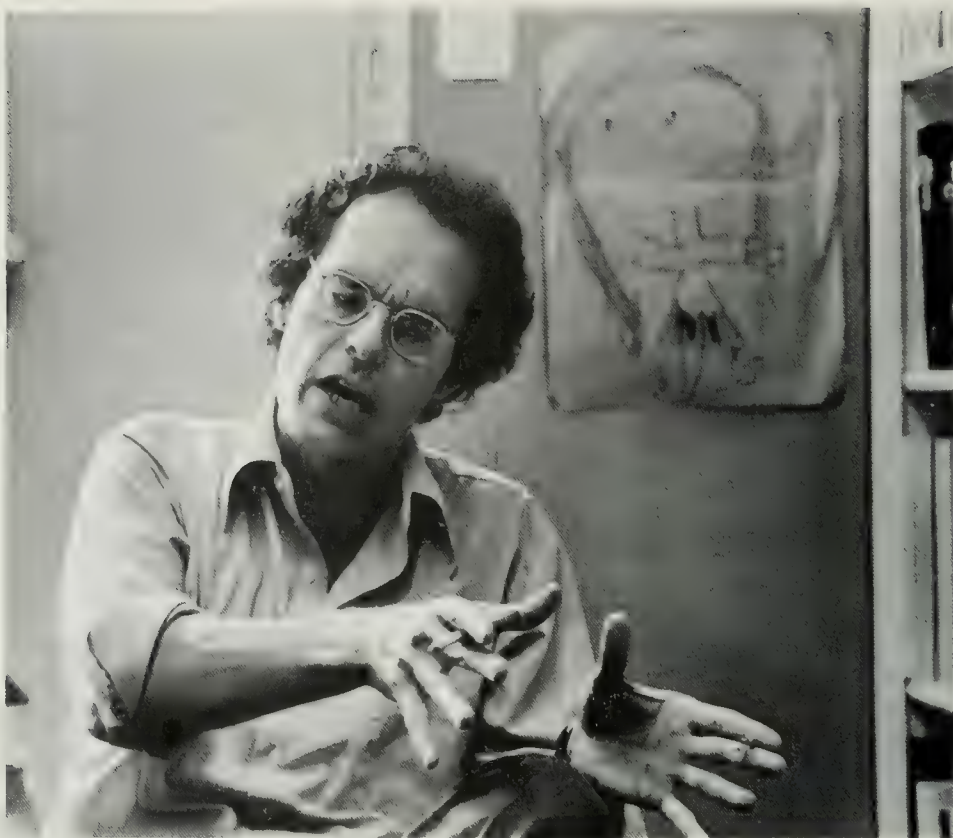
Cooperative Programs with Neighboring Universities

Interchange of Registration. (See Registration, the section on Reciprocal Agreements with Neighboring Universities.)

Library Exchange. Through a cooperative lending program, graduate students of the University of North Carolina and Duke University are granted loan privileges in both universities.

Cooperative Program in Russian and East European History. The graduate schools of Duke University and the University of North Carolina offer a cooperative program leading to the A.M. and Ph.D. degrees in several disciplines (economics, history, literature, linguistics, political science, and sociology), with a concentration in Russian and East European studies. Students admitted to one institution are encouraged to enroll in courses advantageous to their programs at the other institution, and to utilize the libraries and facilities of both universities. The holdings of the two libraries in Russian and East European materials are substantial and complementary. Both libraries have a policy of purchasing all significant published works in Slavic history, economics, government, geography, literature, and linguistics. Other joint activities include a monthly colloquium involving the personnel of the two institutions and distinguished visiting scholars.

A special project of the Duke program has been to assemble an outstanding collection of Soviet underground (*Samizdat*) literature (including letters and manuscripts) which is widely exhibited. Part of the project is an ongoing work on an annotated bibliography.



A research program in Soviet economics (input-output analysis) provides special training for graduate students in this field and publishes a series of monographs under several private foundation and government grants.

Center for Demographic Studies

A Population Studies Program was established at Duke University in 1963 to promote research and training in demography and human ecology. The program was renamed the Center for Demographic Studies in 1972 in recognition of its broad multidisciplinary focus and expanded research program. The facilities of the center include a population library and extensive data resources. These are available to the entire Duke community.

Training under the auspices of the center leads to a Ph.D. degree within either the Department of Sociology or the Department of Economics. Although degrees are awarded through either department, the program is designed to provide an integrated cross-disciplinary training in the common specialty area of population studies. The bearing of sociological and economic theory upon the analysis of demographic phenomena is emphasized, and participation in active research projects is afforded center trainees.

In addition to course and research opportunities which are open to interested graduate students in the University, a weekly noncredit seminar meets throughout the academic year for presentations by students, staff, and visiting guest lecturers.

The center's program of extramural research stresses, but is not limited to, applied work in the demography of aging, health, mortality, and migration.

Graduate fellowships for students in the training program are available. Inquiries may be directed to Dr. George C. Myers, Director, Center for Demographic Studies, Box 4732, Duke Station, Duke University, Durham, North Carolina 27706.

Duke Environmental Center

The purposes of the Duke Environmental Center are to focus attention on pressing environmental problems, to provide orientation and educational opportunities in environmental subjects for both students and faculty, to promote interdisciplinary environmental research, and to serve as a point of contact for University and environmental agencies and the public. The center does not offer degrees, but allows students and faculty to emphasize the environmental aspects of their studies and research by becoming affiliated with the center while remaining in their established departments and professional schools. The center sponsors a visiting speaker program, graduate and faculty seminars, and graduate and undergraduate courses in environmental studies.

Information on environmental programs and courses offered at Duke and other institutions in the Research Triangle and on internships and opportunities in environmental careers may be obtained by writing or visiting the Environmental Center Office, 118 School of Engineering, Duke University, Durham, North Carolina 27706.

The University Program in Genetics

The University Program in Genetics was established to provide for the coherent development of instruction and research in genetics throughout the University. The faculty of the program consists of scientists holding primary appointments in the various biological science departments. They have developed an interdepartmental graduate curriculum designed to meet the needs of students with a variety of educational backgrounds and professional objectives. Students in any of the science departments may specialize in the discipline of genetics under the auspices of the University Program in Genetics.

For current information consult Professor W. R. Guild, 138 Nanaline H. Duke Building, Duke University, Durham, North Carolina 27710.

Hispanic Studies Program

The Graduate School offers an interdepartmental program in Hispanic studies leading to the A.M. and Ph.D. degrees. Students may write their theses and take their degrees in anthropology, history, economics, political science, sociology, or Hispanic languages and literature. The purpose of the program is to provide a desirable combination of courses on the Hispanic world in these disciplines and to give candidates more rigorous training in Hispanic studies. In consultation with the candidate, a faculty committee will determine a special program of study.

The holdings of the Perkins Library for graduate work and research in Hispanic American history, inter-American relations, economic history, politics, art, and Spanish American literature are constantly being enlarged.

Islamic and Arabian Development Studies.

A program of Islamic and Arabian Development Studies was started in 1977 assisted by grants from the government of Saudi Arabia and several corporations in the United States. The program embraces a distinguished lecture series which,

during the 1978-79 academic year, brought to Duke six distinguished lecturers on Islamic and Arabian affairs. A similar lecture series will be given in subsequent academic years. The program also embraces an outreach program which includes the College of Charleston, the University of North Carolina at Charlotte, Southwestern University at Memphis, and the Southern Center of International Studies.

An international conference on problems of development of the Arabian Peninsula is planned for 1980 and a southeastern regional conference on the same topic is planned for 1979. The program also supports the teaching of three years of Arabic and assists the interdisciplinary course in Islamic civilization by scheduling the distinguished lecture series at the time that course meets.

The program also sponsors graduate seminars from time to time. In 1980 it will offer a senior graduate seminar on comparative development problems in the Islamic world.

Medical Scientist Training Program

The Medical Scientist Training Program, conducted under the auspices of the Graduate School and the School of Medicine, is designed for students with a strong background in science who are motivated toward a career in the medical sciences and academic medicine. It provides an opportunity to integrate graduate education in one of the sciences basic to medicine with the clinical curriculum of the School of Medicine. The program usually requires six to seven years of study and leads to both the M.D. and Ph.D. degrees. Although the special emphasis of this program is on basic medical science, the trainees, because of their education in clinical medicine, have a remarkable range of career opportunities open to them. Graduates of this program generally follow one of two broad paths. Some directly pursue careers in teaching and research in one of the basic medical sciences, while maintaining strong ties with clinical science as a result of their combined training; others enter residency programs before pursuing investigative and teaching careers in clinical medicine, carrying with them strong academic backgrounds in the basic sciences.

Eligibility. Applicants must meet the admission requirements of both the Graduate School as a candidate for the Ph.D. degree and the School of Medicine as a candidate for the M.D. degree. Most candidates apply for admission to the first year of the program, but applications are accepted from students who are currently in residence in the Graduate School or School of Medicine of Duke University. In addition to the minimum requirements for acceptance in the Graduate School and the School of Medicine, advanced course work in science and mathematics as well as prior research experience count heavily in the selection of candidates.

Financial Support. Students admitted to the first year of the program in 1979 will receive a traineeship award, consisting of a stipend and full tuition allowance, provided by a grant from the National Institutes of Health. The annual stipend is \$3,900. Current policy of the National Institutes of Health limits the duration of the traineeship to six years; support will be continued for that period (or until the completion of both degrees, if earlier), provided that progress remains satisfactory. This traineeship, created by the National Research Service Award Act of 1974 (PL 93-348) provides (as do all research training awards under this act) for certain alternate service or payback requirements in the event that a research career is not pursued. Support by the NIH under the National Research Service Award Act requires the recipient to be a citizen or resident of the United States.

The Training Program. This program has been designed to offer trainees latitude in the selection of course material. Basic requirements are two academic years composed of the first basic science year and the second clinical science year

of the curriculum for medical students at Duke University. Following completion of the second year, the trainee enters the graduate program to complete the requirements for the Ph.D. degree. A final academic year of elective clinical study is necessary to complete the requirements for the M.D. degree. Both degrees are awarded at the completion of this sequence.

Additional information may be obtained by writing Professor Henry Kamin, Associate Director, Medical Scientist Training Program, Department of Biochemistry, Duke University Medical Center, Durham, North Carolina 27710.

The Medical Historian Training Program

The Medical Historian Training Program is conducted under the auspices of the School of Medicine and the Graduate School. The M.D.-Ph.D. program requires a minimum of six years of graduate study, and the M.D.-A.M. four or five years, depending on the use of summer terms. The M.D.-Ph.D. program is intended for those students who know that their major career effort will be in teaching and other scholarly activities in the history of medicine (not necessarily to the total exclusion of clinical medicine). The M.D.-A.M., on the other hand, is appropriate for those who are undecided, but who wish to acquire a firm foundation for future study. It is also appropriate for those who are seriously interested in pursuing an avocation in the history of medicine. In both programs the first two years and the last year will be spent in the medical school. All requirements for the Ph.D. and the A.M. must be completed before the final year of the M.D. program.

Application and Admission Procedures. Applicants must meet the requirements for admission to the School of Medicine and the Graduate School in the Department of History. Candidates who have completed two years of medical school will also be considered.

In addition to the minimum requirements established by the School of Medicine and the Graduate School, courses already taken in history and the history and philosophy of science will count in the selection of candidates. Those candidates holding the M.D. degree are accepted for the Ph.D. and the A.M. degree.

Applicants should complete and submit an application to the Graduate School for admission to the Department of History.

Additional information may be obtained by writing to John Crellin, Ph.D., M.D., Director, Medical Historian Training Program, Box 3702, Duke University Medical Center, Durham, North Carolina 27710.

Institute of Policy Sciences and Public Affairs

The graduate program in public policy sciences is offered through the Institute of Policy Sciences and Public Affairs. The objective of the program is to prepare students for public sector jobs which require analytical skills and a practical understanding of the process by which policy is made and implemented.

The A.M. degree requires two academic years and a summer internship. The first year is devoted to core courses in policy analysis, including sequences in quantitative methods, economics, political analysis, and ethics. The summer internship is arranged with a federal or state agency. The second year curriculum includes course work in public management, a concentration in a substantive policy area, and a masters paper to be researched and written on a problem of current policy concern.

Students who are concurrently enrolled in a Ph.D. program or a professional degree program (M.D., J.D., M.B.A., M.H.A., etc.) or who have already obtained

such a degree, can apply for an abbreviated version of the A.M. program. Such students are excused from all the requirements of the second year except for the masters paper, so ordinarily completing the A.M. requirements adds only one year to their graduate programs. Students usually apply for a joint degree program simultaneously with their applications to the graduate departments or professional schools, or during their first or second year of advanced study.

The institute does not award a Ph.D.

Additional information concerning the A.M. programs can be obtained by writing the Director of Graduate Studies.

Oak Ridge Associated Universities

Duke University is one of the sponsoring universities of the Oak Ridge Associated Universities located at Oak Ridge, Tennessee. The graduate research program at Duke has available to it all the facilities of the Oak Ridge National Laboratory and the cooperative supervision of student research by the staff at Oak Ridge. Fellowships in several fields of science are available to qualified applicants.

Graduate Fellowship Program. On application by a university, ORAU awards fellowships to candidates for the master's and doctor's degrees. The student uses the fellowship to conduct thesis research in certain federal laboratories.

The application deadlines depend upon the fellowship. Further information may be obtained from Dr. Boyd R. Strain, Department of Botany, Duke University, Durham, North Carolina 27706.

Organization for Tropical Studies

Duke University is a member of an international consortium created to promote an understanding of tropical environments and how to use them intelligently. To achieve these objectives, the Organization for Tropical Studies (OTS) fosters research and research training programs in the New World tropics.

Fellowship applications are available from the Graduate School for travel and subsistence in field-oriented programs conducted primarily in Costa Rica. The basic OTS course, Tropical Biology: An Ecological Approach (8 units), runs for an eight-week period in January-February and in July-August. Advanced offerings are scheduled periodically in agriculture, anthropology, botany, earth sciences, forestry, geography, marine biology, meteorology, and zoology.

The course schedules and application deadlines vary from year to year. Consult Dr. Donald Stone (botany), Dr. Peter Klopfer (zoology), or Dr. Kenneth Glander (anthropology) for information.

Program in Medieval and Renaissance Studies

The graduate Program in Medieval and Renaissance Studies is administered by the Duke University Committee on Medieval and Renaissance Studies. A participating student is based in one of the regular departments and fulfills the Ph.D. degree requirements for that discipline. In addition, students take a program of electives which will advance their interdisciplinary competence in the medieval or Renaissance areas. Such a program may include a choice from the fields of art history, language and literature, history, philosophy, and religion. Participation in the Program in Medieval and Renaissance Studies will fulfill the requirement for work in a related field.

The Committee on Medieval and Renaissance Studies awards annual fellowships to outstanding doctoral students. Each fellowship is renewable twice, with renewal based on a review of the student's program by the committee.

The Committee on Medieval and Renaissance Studies also sponsors an undergraduate program; the *Journal of Medieval and Renaissance Studies*, a monograph series in the field; and lectures by distinguished visiting scholars.

Inquiries should be addressed to the Chairman, Duke University Committee on Medieval and Renaissance Studies, Box 4666, Duke Station, Durham, North Carolina 27706.

The Round Table on Science and Public Affairs

The Round Table on Science and Public Affairs is an activity of the Duke University Graduate School with the following purposes: to inform members of the academic community concerning the constructive roles of science and engineering in society, to encourage scientists and engineers to contribute to the solution of societal problems in those instances where their special competence is relevant, to contribute to the preparation of scientists and engineers for careers in public service, to contribute to the improvement of education in science at the precollegiate levels, and to increase the public's understanding of science and technology and their place in the modern world.

As part of this commitment, the round table each year arranges a series of public lectures and coffee hours at which leading experts discuss major national and international problems to which science and technology are related.

The round table also sponsors a postdoctoral program, Training the Behavioral Scientist for a Role in the Legislative Setting, to prepare Ph.D.s for service as professional legislative staff officers to serve with committees of Congress and similar organizations in state legislatures. This is a two-year program for each fellow. The first year is spent on the Duke campus and involves working on special projects. In cooperation with the AAAS Congressional Fellowship Program, the second year is spent with the United States Congress on assignment to an appropriate staff or committee.

For further information contact Professor William Bevan, Director, The Round Table on Science and Public Affairs, The Graduate School, Duke University, Durham, North Carolina 27706.



Resources for Study



The Libraries

The libraries of the University consist of the Perkins Library and its eight branches on campus—Biology-Forestry, Chemistry, Divinity, East Campus, Engineering, Music, Physics-Math, and Undergraduate; and the Pearse Memorial Library at the Duke Marine Laboratory in Beaufort; the School of Law Library; and the Medical Center Library. In June 1978, these libraries contained approximately 2,900,000 volumes and ranked nineteenth in size among academic libraries in the United States. More than 14,000 periodicals, 20,000 serials, and 200 newspapers are received regularly. The collection includes about 5,000,000 manuscripts, 80,000 maps, 35,000 sheets of music, and 280,000 items on microfilm.

In addition to noteworthy holdings in British history, English literature, American history and literature, Commonwealth studies, Latin American history, religion, and science, the libraries include several distinguished special collections of international reputation such as the George Washington Flowers Collection of Southern Americana, the Baker Collection of Wesleyana and British Methodistica, the Mazzoni Collection of Italian Literature, the Perez de Velasco Collection of Latin American History, the Trent Collection of Walt Whitman, the Trent Collection in the History of Medicine, and the Strisower Collection of International Law.

The William R. Perkins Library

Collections. The William R. Perkins Library—the main library of the University—houses most of the books and journals in the humanities and social sciences, large files of United States federal and state documents, public documents of European and Latin countries, publications of European academies and learned societies, and special collections from South Asian, Far Eastern, and Slavic countries. The newspaper collection, with 16,000 volumes and 30,000 reels of microfilm, has several long eighteenth-century files, strong holdings of nineteenth-century New England papers, antebellum and Civil War papers of North Carolina, South Carolina, and Virginia, as well as many European and Latin American papers. The manuscript collection of approximately 5,000,000 items is particularly strong in all phases of the history, politics, and social and economic life of the South Atlantic region, and includes significant papers in English and American literature. The rare books collection contains scarce and valuable materials covering a broad range of fields. The Latin and Greek manuscript

collection constitutes one of the outstanding groups of its kind in the United States. The collection of Confederate imprints is the largest in the country.

The branch libraries serve the academic disciplines bearing their names. The East Campus Library is primarily for undergraduate use; however, it also contains the principal collections for graduate and undergraduate study in art.

Control Desk. In order to guarantee the orderly functioning of the Perkins Library for the benefit of all members of the University community, control desk attendants have been stationed at the library's principal exit and are authorized to examine all books and other library materials that people leaving the library may be carrying in their hands, briefcases, or bags to determine if they are properly charged. Anyone who refuses to permit books to be examined may be denied further use of the library.

Library Carrels. A limited number of closed and open carrels are available in the various libraries. Assignments ordinarily are made for the academic year; carrels not being used may be reassigned. Moreover, they will be reassigned if not renewed for each summer session or for the academic year. Graduate students may apply for a carrel through the head of the circulation department in Perkins Library.

Interlibrary Loans and the Libraries of the Consolidated University of North Carolina. The Duke University library provides the usual interlibrary loan services. Graduate students may borrow directly from the libraries of the Chapel Hill, Raleigh, Greensboro, and Charlotte campuses of the University of North Carolina after acquiring a borrower's card from the Circulation Department of Perkins Library. There is daily delivery service between the Duke University library and the libraries of the University of North Carolina at Chapel Hill and North Carolina State University at Raleigh.

Reproduction of Library Materials. The library has microfilming, photoduplication, and Xerox services. The rules with regard to copyright and a schedule of fees for reproduction services are available in the library at the point of service.

The Medical Center Library

Collections. The Medical Center Library, located in the Seeley G. Mudd Communications Center and Library Building on the Medical Campus, provides services and informational resources necessary to further education, research, and clinical activities in the medical field. In addition to the faculties and students in the Schools of Medicine, Allied Health, and Nursing, and Medical Center graduate departments, the library serves the professional and technical staffs of Duke Hospital as well as other health professionals throughout North Carolina. Over 160,000 volumes are available. Approximately 2,850 journal subscriptions are received currently.

The History of Medicine Collections, including the Josiah C. Trent Collection, consist of rare books and manuscripts and a supporting group of histories, biographies, bibliography, pictures, and ephemeral materials. The rare books are available to all, but are restricted to library use. Most modern books may be borrowed. The History of Medicine Collections also include the Duke Authors Collection which preserves an archival copy of each book published by a member of the Duke medical faculty.

The Frank Engel Memorial Collection consists of a small group of books for leisure reading in nonmedical subjects, supplemented by several newspapers and popular magazines.

A reserve collection of heavily used books and journals is maintained in the Medical Sciences Branch Library located in the Nanaline H. Duke Building, and covers the fields of biochemistry, genetics, pharmacology, and physiology.

The School of Law Library

The School of Law Library, with approximately 240,000 volumes (twenty-sixth in size among law school libraries), serves both the University and the local legal community. The collection contains nearly all reported decisions of the federal, state, and territorial courts of the United States, British Commonwealth, and representative foreign jurisdictions. It also includes the constitutions, codes, statutes, and subsidiary legislative publications of all these jurisdictions as well as many digests, indexes, bibliographies, and related research tools. A large section of the library collection is devoted to treatises on all phases of law and legal sciences, as well as to materials in the fields of history, economics, government, and other social and behavioral sciences relevant to legal research. There are files of selected federal documents, and since 1970 a complete set of congressional materials has been maintained. The Christie Jurisprudence Collection is located in the main reading room. Other collections include legal history, administrative materials, intellectual property, criminal procedure, school law, and briefs of the United States Supreme Court, the Fourth Circuit Court of Appeals, the North Carolina Supreme Court, and the North Carolina Court of Appeals. Undergraduate and graduate students whose course of study requires access to legal literature should obtain permission from the law librarian to use the collections.

Record Library

The Department of Music has a record library separate from the university libraries. Its Arts Council collection of records is available to members of the community on a rental basis. The Departmental collection and the Mary Duke Biddle Collection are both available only to the faculty of the Department of Music. However, other faculty members may, with permission, borrow records from these two collections for use in their classes. The record library also has some limited facilities for listening to records and tapes.

University Archives.

The Duke University Archives, the official archival agency of the University, collects, preserves, and administers the records of the University having continuing administrative or historical value. The institutional archives, which also include published material, photographs, papers of student groups and faculty, and selected memorabilia, are available for research under controlled conditions in 341 Perkins Library.

Science Laboratories

Botanical and Zoological Laboratories. Facilities for graduate study in the Departments of Botany and Zoology are located on the West Campus. The Biological Sciences Building contains well-equipped modern laboratories for teaching and research in the fields of botany, forestry, and zoology. Special facilities include animal rooms, greenhouses, darkrooms, refrigerated and controlled-environment laboratories, scanning and transmission electron microscopes, a Van de Graaf accelerator, X-ray machines, radiation and radioisotope equipment, and other modern research facilities. Extensive facilities for experimentation in environmental control of plant growth are available in the phytotron adjacent to the botany greenhouses.

The herbarium contains over 360,000 specimens and includes notable collections of mosses and lichens. Other assets for teaching and research are the Sarah P. Duke Gardens on the West Campus; the 4-acre experimental plot and field laboratory developed by the Department of Botany; the Duke Forest, comprising 8,000 acres of woodland adjacent to the West Campus; the field station for the study of animal behavior; and the Duke University Marine Laboratory at Beaufort, North Carolina. Duke University, through the botany and zoology departments, is a member institution of the Organization for Tropical Studies, Inc., a consortium of universities with field station facilities in Costa Rica that provide opportunities for course work and research in tropical science.

Scholarships for advanced study during the summer months are available through the Highlands Biological Laboratory, Highlands, North Carolina. Requests for information concerning scholarships at the Highlands laboratory should be addressed to the botany department.

The Phytotron. The phytotron, officially known as the Duke University unit of the Southeastern Plant Environment Laboratories, is adjacent to the Biological Sciences Building and is administered by the botany department. The phytotron is an integrated series of plant-growth rooms, chambers, and greenhouses, with forty-six separately controlled environments providing more than 4,000 square feet of plant-growing space. The factors of the environment controlled in the units to study plant growth include light, temperature, nutrients, carbon dioxide concentration, and humidity. By using the conditions in various day and night combinations, an exceptionally large number of environments can be simulated for testing the growth responses of plants. The phytotron also includes research laboratories and facilities for studying and monitoring the physiological processes of plants.

Research space in the phytotron is available to graduate students and faculty at Duke and to members of other educational and research organizations. For information concerning awards and research space, contact Dr. Henry Hellmers, Director of the Phytotron, Department of Botany, Duke University, Durham, North Carolina 27706.

Marine Laboratory. The Duke University Marine Laboratory (DUML) is located at Beaufort, North Carolina, on Pivers Island, with direct access to the open ocean, numerous bars and shoals, maritime marshlands, and various tributaries. The laboratory employs over 100 persons and accommodates nearly 2,000 students per year, including 15 to 20 graduate students in residence year-round. Offerings include a full undergraduate spring term, two international training programs, a cooperative undergraduate teaching program with thirteen participating universities, and three terms of summer school courses for graduates and undergraduates. These courses fulfill graduate credits in the Departments of Zoology, Botany, Geology, Chemistry, Biochemistry, Physiology, and Pharmacology. The physical plant consists of twenty-three buildings, including six air-conditioned laboratories, one classroom building, five dormitories, a maintenance complex, and a dining hall. The laboratory has several small skiffs; three intermediate-size vessels; a 58-foot trawler, the R/V *Beveridge*; a new 62-foot research-workboat, the R/V *John de Wolf II*; and a 118-foot oceanographic research vessel, the R/V *Eastward*.

For information concerning teaching and research space, write to the Business Office, Duke University Marine Laboratory, Beaufort, North Carolina 28516. For information concerning courses, refer to the Marine Laboratory bulletin or to Marine Sciences—the University Program in the chapter on Courses of Instruction.

Animal Behavior Station. The Animal Behavior Station, located less than one mile from campus, provides facilities for the study of penned, free-ranging, and caged animals in a wooded area of eighty acres. These facilities include sound-

proofed observation chambers, barns, aviaries, pens for large animals and birds, and two waterfowl ponds. An extensive facility for the study of prosimian primates was completed in 1968. It contains one of the world's largest collections of lemurs in rooms especially designed for observational and behavioral studies. For information regarding research space or research assistantships in animal behavior, write to Dr. P. H. Klopfer, Department of Zoology, Duke University, Durham, North Carolina 27706.

Primate Center. The Duke University Primate Center is located in the Duke Forest adjacent to the Animal Behavior Station, about two miles from the main campus. The colony is composed of approximately 300 prosimian primates representing eighteen varieties. The animals are utilized by faculty members and students in the Departments of Anatomy, Anthropology, Psychology, and Zoology for research in cytogenetics, comparative anatomy, animal behavior, and physiology. Information concerning graduate study in one of these areas should be directed to the Director of Graduate Studies of the appropriate department. For information pertaining to the use of the Primate Center and availability of research space, write to Dr. Elwyn L. Simons, Director, Duke University Primate Center, 3705 Erwin Road, Durham, North Carolina 27705.

Physics Laboratories. The Physics Building, containing about 103,000 square feet of floor space, is devoted to research and instruction in the Departments of Physics and Mathematics. An additional 27,000 square feet of space is provided in the adjacent Nuclear Physics Building completed in 1968. Graduate students usually have office space in one of these two buildings.

In addition to the lecture halls and the elementary laboratories, there are instructional laboratories for work in electronics and advanced physics.



Nearly half the building is devoted to special laboratories for research in microwave spectroscopy and atomic, nuclear, high energy, low temperature, and solid state physics. Special equipment includes microwave spectrographs operating up to 500,000 megacycles; one 4 MeV and one high-resolution 3 MeV Van de Graaf accelerator, a 30 MeV cyclotron/tandem Van de Graaf accelerator, a helium liquefier, cryostats, magnets, and associated equipment for research down to the millidegree Kelvin temperature range; a Sigma-5 and a DDP-24 computer used for automatic measurement and processing of bubble chamber film in the high energy physics laboratory; and two DDP-224 computers used to collect and process data in the nuclear structure laboratory.

The Physics-Math Library contains a large selection of books and periodicals. A spacious, well-equipped instrument shop located in the building is staffed by ten instrument makers, ten electronics technicians, and a glassblower.

Chemistry Laboratories. The Department of Chemistry is housed in the Paul M. Gross Chemical Laboratory, a building containing 146,440 square feet of total area. The well-equipped chemical laboratory provides conditions conducive to research in many areas of current interest. Nuclear magnetic resonance facilities include 60 MHz, 100 MHz, and Bruker 90 MHz spectrometers. The latter instrument is equipped with a complete range of decoupling accessories, as well as Fourier transform capabilities for ^{19}F , ^{15}N , ^{13}C , ^{31}P , and ^1H nuclei. Two ESR spectrometers, including a Varian E-9, provide excellent facilities for research in electron spin resonance. Mass spectrometric service is provided by a CEC 21-491 mass spectrometer and a Hewlett-Packard GC-MS system, as well as access to an A.E.I., Ltd., MS-902 located in the Research Triangle Park. X-ray diffraction cameras of all types are available, along with Enraf-Nonius automatic and Picker automatic full-circle diffractometers. Numerous instruments of varying sophisti-



cation for fluorescence, infrared, u.v., and ORD-CD spectroscopy are available. Several preparative and analytical gas and liquid chromatographs are also located in the building. Computing facilities include PDP-81L and PDP-81F laboratory computers and an IBM 370/165, the latter located in the Research Triangle Park and linked by microwave to the Duke University Computation Center. The department has a machine shop, an electronics shop, and a glassblowing shop. The facilities of the Duke University Marine Laboratory on the coast at Beaufort, North Carolina, are available for specimen collecting and processing studies of organic chemicals of marine origin. The Department of Chemistry Library is also located in the Paul M. Gross Chemical Laboratory, with holdings of approximately 30,000 volumes. The library receives 310 current scientific periodicals and has a terminal facility for complete information retrieval.

The Medical Center. Over the years the Medical Center has been enlarged and its programs expanded by new construction and by the acquisition of, and affiliation with established hospitals.

Currently the Medical Center occupies approximately 120 acres. The southern portion is contiguous with the main quadrangle of the University and consists of the following: Davison Building, Duke Hospital South, Baker House, Barnes Woodhall Building, Diagnostic and Treatment Building, Gerontology Building, Clinical Research I, Clinical Research II, and the Edwin A. Morris Clinical Cancer Research Building.

The northern portion includes the Nanaline H. Duke Medical Sciences Building, Alex Sands Medical Sciences Building, Edwin L. Jones Basic Cancer Research Building, Medical Research Building, Bell Building, Seeley G. Mudd Communications Center and Library, Searle Center for Continuing Education, Eye Center and Duke Hospital North (under construction and scheduled for completion in 1979).

In the western section of the campus are: Research Park Buildings I, II, III, and IV, the Vivarium, and the Animal and Laboratory Isolation Facility.

In the eastern section of the campus are Pickens Rehabilitation Center, Civitan Mental Retardation and Child Development Center, and Trent Drive Hall.

Psychology Laboratories. The psychology department occupies approximately 53,000 square feet of air-conditioned space on the main campus, in a building which houses general purpose laboratories, seminar rooms, classrooms, and a number of special facilities. For the study of animal behavior there are videotape-recording facilities, a breeding colony of ring doves and pigeons, an extensive collection of prosimians, and operant-conditioning laboratories. There are sound-proofed and electrically shielded rooms for use with human and animal subjects, rooms for computer-controlled experiments in human perception and memory, photographic darkrooms, electrophysiological recording rooms, and a histological laboratory and surgery. The social psychology unit (used jointly with the Department of Sociology) contains observation, communication, and videotape-recording facilities for the study of social interaction. There are interview and observation rooms for the study of human personality and clinical processes and a fully equipped experimental trailer for studying the behavior of children on location. Laboratory computers, some with graphics capability, and remote access to the IBM and Hewlett-Packard computers located at the Triangle Universities Computation Center are available in the building. Machine, wood, and electronics shops are staffed by three full-time technicians. Other facilities for research and teaching are available in the laboratories and clinics of the adjacent Duke Medical Center.

A number of clinical installations for adults and children, specializing in clinical and guidance problems, cooperate with the department in providing

facilities for research and training. The department runs an experimental school for first- and second-grade and preschool children, and cooperates with the Department of Zoology in operating an eighty-acre field station and primate facility in nearby Duke Forest for the study of animal behavior in natural settings (see Animal Behavior Station).

Computation Center. Extensive computer resources are essential for a contemporary university. Computing is provided at Duke by the Duke University Computation Center. The center is presently equipped with an IBM System 370 Model 138 computer with 1024K bytes of memory, one 3330 disk facility, five tape drives, two card readers, a card punch, three printers, and a digital plotter. This computer is connected by a high-speed microwave link to the Triangle Universities Computation Center (TUCC) located in the Research Triangle Park.

TUCC is a regional computer network formed and operated jointly by Duke University, North Carolina State University at Raleigh, and the University of North Carolina at Chapel Hill. The computer equipment at TUCC consists of two IBM System 370 Model 165s with four million bytes of memory each, one 2314 and multiple 3330-type disk facilities, seven tape drives, drums, card readers, and printers. Also available are two small Hewlett-Packard 2000 Access computers which provide BASIC interactive computing.

Duke's IBM 370 Model 138 is used mostly for administrative computing and as a high-speed link to TUCC. Also connected to TUCC are four medium-speed terminals (card reader and printer) located in the Engineering Building, the Biological Sciences Building, the Sociology-Psychology Building, and on East Campus, as well as several low-speed keyboard terminals located at various points on campus.

All users of the Computation Center facilities are urged to obtain funds to pay for computer services. Users unable to obtain grant funding may ask for financial support from their departments when applying for services. More specific information regarding Duke computing facilities may be obtained from the Director of the Computation Center.

Engineering Research Laboratories. The laboratories of the four departments of the School of Engineering contain extensive basic equipment that may be applied in several specialized fields. Each laboratory also contains selected sophisticated equipment used in advanced research. The facilities available for instruction and research are suggested by the following brief listing of equipment found in each department:

Biomedical Engineering. Holography and ultrasound apparatus; cellular electrophysiology and neurophysiology instrumentation; stereomicroscope, micromanipulators, stimulators, isolation units, and microelectrode puller; facilities for studying biomedical materials and surface interactions; polarizing microscope, internal reflectance infrared spectrophotometer, and dialyzers; soft tissue creep and relaxation test system; biocellular material testing equipment; cardiorespiratory measurements; respirator; a DEC PDP-12 and several PDP-11 digital computers.

Civil Engineering. Well-equipped research laboratories are available for work in environmental engineering, soil mechanics and geotechnical engineering, solid mechanics and materials engineering, structural mechanics and structural engineering, fluid mechanics, water resources and ocean engineering, and urban systems and transportation engineering. Available research facilities include two independent closed-loop electrohydraulic dynamic loading systems (MTS) capable of applying pulses of any shape and controlled in force or displacement modes, frequency range up to 100 cps., load capacity 6,000 and 100,000 lbs. (the 6,000 lbs. actuator can develop a constant crosshead speed up to 50,000 in./min.); equipment

for manufacture and testing of fiber-reinforced polymer composites; environmental chamber for testing in the temperature range of -320° to 500° F.; ultra-high-pressure triaxial shear apparatus for confining pressures up to 100,000 psi; high-speed camera for studying explosions and similar phenomena; particle tracking X-ray equipment for soil deformation studies; rock-testing facilities; model-testing equipment for anchored walls, penetrometer studies, and deep pile foundations; a large-aperture research polariscope; a reflective photoelastic polariscope; sustained-loading facility for long duration in studies of prestressed concrete; and a PDP-8 digital computer with an 16K core memory size, teletype console, paper tape and magnetic tape I/O capabilities, and teletype terminals which may also be connected to the IBM 370/165 and HP 2000 Access computers at the Triangle Universities Computation Center. There is also a batch terminal connected to the IBM 370/165.

Electrical Engineering. Digital data processing laboratory equipped with DEC PDP-8/I and PDP-11/45 computers including graphic displays, X-Y tablets, and remote input-output terminals; microwave facilities for experimentation up to 35 GHz; X-ray diffractometer with monochromator and low temperature attachments; cryomagnetic Faraday balance for magnetic susceptibility measurements; EPR spectrometer; 4 inch and 9.5 inch electromagnets; and 2 inch-bore superconducting magnet.

Mechanical Engineering and Materials Science. Digital data acquisition system with high speed scanner and magnetic tape; FM-AM instrumentation recorder; four-square foot subsonic wind tunnel with six-component balance; hot-wire anemometer system; storage and dual-beam oscilloscopes; X-Y and strip chart recorders; temperature, pressure, strain, force, and acceleration transducers; electrodynamic shaker table; sound room; spectrum analyzers; MiniAC and TR-20 analog computer facilities; D17B Minuteman digital minicomputer; CRT Data I/O terminal with hardcopy unit; fuel research engine; materials laboratories with stereo zoom research metallograph, polarizing and low-temperature microscopes, electron microscope, thermal analyzer, Instron testing machine, high vacuum system, instrumented plastics extruder and injection molder, 10 kw RF generator, heat treating and arc-melting furnaces, recorders, constant load stress corrosion tester, and darkroom facilities.

The School of Engineering is associated with the F. G. Hall Laboratory for Environmental Research at the Duke University Medical Center where opportunities are provided for research in environments from pressures of 1 Torr (155,000 feet of altitude) to 466 psig (1000 feet of depth in seawater) with a variety of gasses, temperatures, and humidities. All basic equipment for measuring and recording physiological and physical phenomena are provided. Experiments may be performed in vitro or in vivo with animals or human subjects. Areas of interest have been heat and mass transfer, fluid flow, and thermal regulation.

The shop facilities of the school, as well as those located elsewhere on campus, are available to graduate students in all four departments.

The School of Engineering houses a Data 100 medium-speed card reader and printer which communicates directly with the IBM 370/165 computer located at the Triangle Universities Computation Center in the nearby Research Triangle Park.

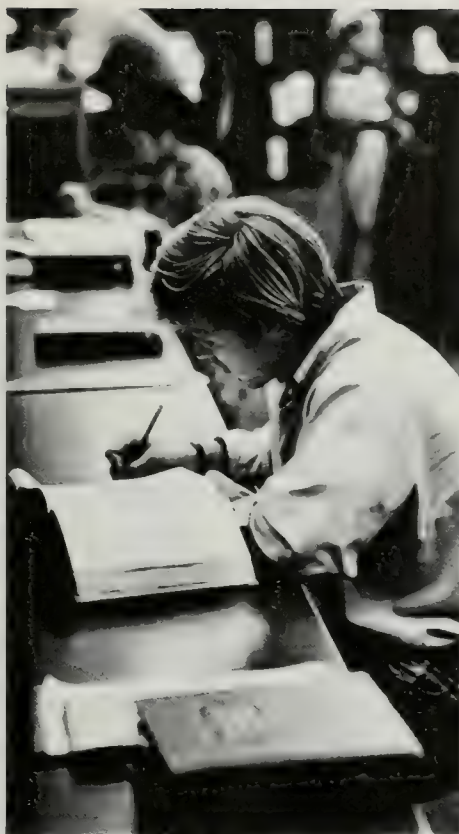
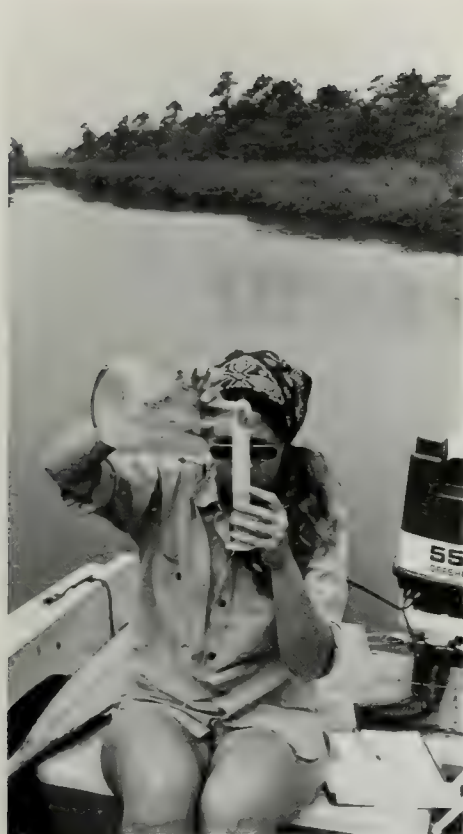
Forestry Sciences Laboratory. The United States Forestry Sciences Laboratory of the Southeastern Forest Experiment Station is located in the Research Triangle Park near Durham. This research organization provides excellent opportunities to complement research conducted by students in the Department of Forestry and Environmental Studies. Specialized research projects in forest entomology, pathology, physiology, and soils are currently underway at the laboratory. The staff of the laboratory is available for consultation and participation in

seminars. Arrangements may be made for students to conduct certain aspects of their research at the laboratory.

Duke Forest. The Duke Forest serves as an outstanding field laboratory for the students and faculty of Duke University. This forest consists of nearly 8,000 acres on which grow various types of trees characteristic of the southeastern Piedmont region. Shortleaf pine, loblolly pine, and southern hardwoods represent the main timber types.

Much of the Duke Forest is adjacent to the campus and easily accessible, providing students and faculty with excellent opportunities to conduct studies in various fields of forestry such as ecology, entomology, land management, meteorology, pathology, physiology, and soils.





Student Life



Living Accommodations

Duke University has several residential facilities in which graduate and professional students reside.

In recent years the number of residence hall spaces for graduate students has been reduced because of reduced demand by graduate students for places to live on campus. Before January, 1979, the University will evaluate the housing situation to determine if residence hall space should continue to be provided for graduate and professional students.

Apartment accommodations for graduate and professional students will be offered in two locations—in the recently completed Central Campus Apartments, and the Town House Apartments, both of which are conveniently located between East and West Campus.

Spaces in apartments for single students are provided on an individual basis with each student paying rent to the University. This method permits each student to plan a budget without the problems of sharing housing costs. Attempts are made to permit students to share apartments with others of their choice. When this is impractical, the Department of Housing Management strives to place persons with like interests together.

Current information on housing for graduate and professional students will be available during the spring semester, 1979, from the Department of Housing Management.

Town House Apartments. Town House Apartments, located in the Central Campus area, is a thirty-two-unit complex, which also houses graduate and professional school students. These apartments are more spacious than the apartments found on campus or in Durham. Because of its location away from the academic facilities of the three campuses, students find that these apartments offer a change from normal campus life and activities. They are available for continuous occupancy, summer months included.

The apartments are furnished for three students. In each apartment choice of the single bedroom is determined by the occupants.

Each air-conditioned apartment includes a living room, master bedroom, one and one-half baths, a single bedroom, and an all-electric kitchen with a dining area. Spacious closets and storage spaces are provided within each apartment.

Occupants must make arrangements with the local utility companies to pay for electricity, gas, and telephone service. These companies usually require a

deposit when initial applications for service are made. Utility companies should be contacted prior to arrival as it usually takes two to three days to obtain service.

Central Campus Apartments. During 1975, Duke University completed a 500-unit apartment complex. These units are available throughout the calendar year for continuous occupancy. All of these apartments are air-conditioned.

Apartments are available for single and married students attending the graduate and professional schools and undergraduate colleges as well as all categories of students receiving instruction in the Allied Health Division of the Medical Center.

For single graduate and professional school students, one-bedroom and three-bedroom apartments are fully furnished; a few furnished efficiencies are also available. It is expected that many more applications will be received for efficiencies than can be accommodated.

Application Procedure. The Department of Housing Management provides students accepted to the University with housing application forms and detailed information on rates, rental agreements, and availability of housing. A completed and returned application form, accompanied by the required \$50 residential deposit, is necessary to be considered for assignment. Applications will be processed on a first-apply, first-assigned basis.

Food Services

West Campus and Trent Drive Hall. The dining facilities on West Campus include two cafeterias with multiple-choice menus. The Oak Room has waitress service and offers full meals and a la carte items. The Cambridge Inn, a self-service snack bar open throughout the day and evening, is located in the West Campus Union. Trent Drive Hall has a public cafeteria and a snack bar, Gradeli's, which is open until midnight.

East Campus. On the East Campus there are two dining halls which serve cafeteria-style meals. Although designed to serve residents on East Campus board plans, all other students may purchase meals there at the guest rate. The Down Under is a late night snack service located in Gilbert-Addoms dormitory, open each night except Friday from 8:00 P.M. until midnight. Because of the large number of students served in the dining halls, it is not possible to provide special diets.

The cost of meals to nonboard students approximates \$5 to \$6 per day, depending on the needs and tastes of the individual.

Services Available

Medical Care. The aim of the Student Health Service is to provide any medical care and health advice necessary to the student as a member of the University community. The Health Service maintains the Student Health Services Clinic located in the Pickens Building on West Campus and the University Infirmary on the East Campus. Emergency transportation can be obtained by the Duke campus police. A separate fee for the Student Health Service is assessed.

The Student Health Service offers varied benefits. To secure them, full-time graduate students must be in residence; during the fall and spring semesters, they must be registered for at least 9 units per semester until they have passed the doctoral preliminary examination, after which they must be registered for at least 3 units in residence. In the summer session, a student must be registered for at least 1 unit of research or 3 units of course work.

The Student Health Services Clinic offers the student outpatient services, routine laboratory and X-ray examinations in the clinic for the treatment of acute illness or injury, and advice and assistance in arranging consultation for medical treatments. Fees for such consultations or treatments must be paid by a student who is not covered by an insurance plan.

The facilities of the University Infirmary are available to all currently enrolled full-time students in residence during the regular academic year. Hospitalization in the University Infirmary is provided for treatment of acute illness or injury as authorized by the Student Health Services Clinic physician. Students are required to pay for their meals while confined to the infirmary.

The resources of the Duke University Medical Center are available to all Duke students and their spouses and children, although any bills incurred at Duke Hospital or any other hospital are the responsibility of the student, if not covered by an insurance plan. The Student Health Program does not provide health care for spouses and dependent children of married students. Coverage of the married student's family is provided in the University's Student Accident and Sickness Insurance Plan for an additional fee.

The University has made arrangements for a Student Accident and Sickness Insurance Plan to cover all full-time students for a twelve-month period. For additional fees a student may obtain coverage for a spouse and a child. Although participation in this program is voluntary, the University requires all graduate students to be financially responsible for medical expenses above those covered by the University Student Health Program through the University Accident and Sickness Policy, a private policy, or personal financial resources. Students who have equivalent medical insurance or wish to accept the financial responsibility for any medical expense may elect not to take the Duke plan by signing a statement to this effect. *Each full-time student in residence must purchase this student health insurance or indicate the alternative arrangement.* The Student Accident and Sickness Insurance Policy provides protection twenty-four hours per day during the full twelve-month term of the policy for each student insured. Students are covered on and off campus, at home, while traveling between home and school, and during interim vacation periods. The term of the policy is from the opening day of school in the fall. Coverage and services are subject to change each year as deemed necessary by the University in terms of costs and usage.

Counseling and Psychological Services. Counseling and Psychological Services (CAPS) is a component of student services at Duke which was formed in July, 1977 by a merger of the former Student Mental Health Service and the former Counseling Center. The purpose of CAPS is to provide a comprehensive, coordinated range of counseling and psychological services to assist and promote the personal growth and development of Duke students. These services are available to all enrolled students.

The professional staff is composed of clinical social workers, psychiatrists, and psychologists experienced in working with young adults. They provide direct services to students including evaluation and brief counseling/psychotherapy regarding a wide range of concerns. These include issues of self-esteem and identity, family relationships, academic performance, dating, intimacy, and sexual concerns.

This year CAPS will begin offering some small group experiences focusing on skills development and special interests. These will explore such interests as anxiety reduction, assertiveness training, committed couples, and communication skills. Interested students may contact CAPS for further information.

As Duke's center for administration of national testing programs, CAPS also offers a wide variety of graduate/professional school admissions tests and professional licensure and certification examinations. Another function of CAPS is

the availability of the staff to the entire University community for consultation and educational activities regarding student development and mental health issues affecting not only individual students but the campus community as a whole. The staff works with campus personnel including administrators, faculty, student health staff, religious life staff and student groups in meeting needs identified through such liaisons. Staff members are available to lead workshops and discussion groups on topics of interest to students.

CAPS maintains a policy of *strict confidentiality* concerning information about each student's contact with the CAPS staff. If a student desires that such information be released to anyone, he/she must give written authorization for such release.

There are no charges for initial evaluation and/or brief counseling/psychotherapy; however, where extended interviews are indicated, a fee commensurate with the student's financial situation will be arranged. If appropriate, referral may be made to other staff members or local resources.

Appointments may be made by calling 684-5100 or coming by the office at 214 Old Chemistry Building, West Campus between 8:00 A.M. and 5:00 P.M. Monday through Friday. If a student's concern needs immediate attention, that should be made known to the secretary and every effort will be made to arrange for the student to talk with a staff member at the earliest possible time.

Office of Placement Services. Duke University maintains an Office of Placement Services which acts as a liaison between the University and potential employers in business and industry, education, and government. All services are offered without charge to Duke students and alumni. The staff is available to talk with graduate students about their future professional plans. Graduate students who wish to register with the office are offered an opportunity to assemble a complete dossier of academic records and recommendations to supplement applications for positions, and to have a permanent file for future reference. Pertinent recommendations should be accumulated while the student is enrolled at Duke. Interviews with representatives visiting Duke are scheduled throughout the year for students registered with the Office of Placement Services.

Student Affairs

Cocurricular Activities. Graduate students at Duke University are welcome to use such University recreational facilities as swimming pools, tennis courts, and golf course, and to affiliate with the choral, dance, drama, music, and religious groups. They may become junior members of the American Association of University Professors and may affiliate with Phi Beta Kappa and social fraternities.

A full program of cultural, recreational, and religious activities is presented by the Associated Students of Duke University, the Office of Cultural Affairs, the Duke University Christian Council, the Duke University Parish Ministry, the Duke University Union, the Office of Student Activities, and recreational clubs. Most programs are open to the entire University community. Inquiries should be directed to the ASDU Office, 104 Union Building; Duke Chapel; the Office of Cultural Affairs, 107 Page Building; the Duke University Union, 207 Flowers Building; or the Student Activities Office, 204 Flowers Building.

The Information Center, Page box office, publications offices, art gallery, meeting rooms, lounges, and games room are located in the Flowers and Union Buildings.

Full information regarding the scheduling of major events and programs for the entire year will be found in the Duke University *Annual Calendar*; detailed and updated information in the *Weekly Calendar*, available each Friday; and the Duke

Chronicle, published each Monday through Friday. Copies may be obtained at the information desk or the calendar office, Page Building.

Graduate Student Association. The Graduate Student Association provides a formal means of communication between the graduate student body and the faculty and administration. Membership in the association is open to all registered graduate students. This student-organized association meets monthly, with representatives present from the graduate enrollment of each department. It is governed by a steering committee elected annually from the membership and, among other functions, provides graduate student representation on campus committees including those concerning the library, housing, and governance.

Research and Publications

The departments of Duke University are devoted to research as well as to instruction. Since a prime purpose of the University is the promotion and diffusion of knowledge, attention in the Graduate School is focused on research and publication. To this purpose, the provost annually appoints a University Research Council which receives applications from members of the various faculties for subsidies in support of research. The policy of this council is to encourage the initiation and completion of substantial research projects.

The Duke University Press was created in 1925 as a successor to the Trinity College Press. It continued the publication of the *South Atlantic Quarterly*, published at Trinity College since 1902, and in 1926 it revived the *Hispanic-American Historical Review*, which had been founded and published from 1918 to 1922 by a group of scholars interested in Hispanic America. In 1929 *American Literature* was begun with the cooperation of the American Literature Group of the Modern Language Association. This journal was followed in 1931 by *Ecological Monographs*, and in 1932 by *Character and Personality* (since 1945 entitled the *Journal of Personality*). In 1935 the press began the publication of the *Duke Mathematical Journal*. Since 1948 it has published *Ecology*, the official journal of the Ecological Society of America. It began publishing *American Literary Scholarship* (an annual) in 1965, the *History of Political Economy* in 1969, and the *Journal of Medieval and Renaissance Studies* in 1971. The press has since assumed the publication of the *Bulletin of the Ecological Society of America* (1970) and *Law and Contemporary Problems* (1975), formerly published by the School of Law. Publication of the *Journal of Health Politics, Policy, and Law* began in 1976.

Since its organization the press has published over 560 volumes. These include seven series: the Duke Historical Publications; the Duke Studies in Religion; the publications of the Lilly Endowment Research Program in Christianity and Politics; those of the Program in Comparative Studies on Southern Asia; Monographs in Medieval and Renaissance Studies; publications of the Consortium for Comparative Legislative Studies; and, largest of all, with forty-three volumes to date, the publications of the Duke University Center for Commonwealth and Comparative Studies.

Visiting Scholars

The libraries and other facilities of Duke University are made available, to the extent practicable, to faculty members of other colleges and universities who wish to pursue their scholarly interests on the Duke campus. Such visitors are not charged unless they wish to participate in activities for which a special fee is assessed. Inquiries pertaining to visiting scholars should be addressed to the department Chairman concerned or the Dean of the Graduate School.

Admission



Students Requiring Admission

Admission is required of all students who intend to pursue study toward a degree offered by the Graduate School and of all nondegree students except those who register as *special students* in the summer session. Students who have discontinued a program of study after earning a master's degree at Duke must, by letter, request permission of the Dean to undertake a doctoral program. All applicants are considered without regard to race, color, religion, sex, handicap, or national origin.

Prerequisites

A student seeking admission to the Graduate School of Duke University must have received an A.B. or B.S. degree (or the equivalent in the case of foreign students) from an accredited institution. The student's undergraduate program should be well-rounded and of such quality as to give positive evidence of capacity for graduate study. Usually the student should have majored in the area of intended graduate study; many departments (see the chapter on Courses of Instruction) list specific prerequisites. Satisfactory scores on the Graduate Record Examination are required by all departments. Students are urged to anticipate the language requirement and are reminded that Educational Testing Service Graduate School Foreign Language tests in French, German, Russian, and Spanish are offered to undergraduate and graduate students at many centers on nationally uniform dates (see Language Requirements).

Procedures

A student seeking admission to the Graduate School should obtain an application form from the Dean of the Graduate School. This should be filled out completely and returned promptly. Each application must be accompanied by a nonrefundable fee of \$25* by check or money order payable to Duke University. In addition, the student should provide the following supporting documents: (1) two copies of the official transcript from each college, university, or seminary attended sent directly to the Dean by the institution; (2) two supplementary transcripts, sent as soon as possible, showing completion of work which was in progress when the earlier transcript was made; (3) three letters of recommendation written, on the

*All fees are based on current charges and are subject to change without notice.

forms provided, by persons best qualified to judge the applicant as a prospective graduate student and mailed directly to the Dean; (4) scores on the Graduate Record Examination Aptitude Tests for applicants to all departments; and (5) scores on the Graduate Record Examination Advanced Test for applicants to programs in biochemistry, botany, chemistry, English, geology, mathematics, microbiology, pathology, physics, physiology, Romance languages, and zoology. Materials submitted in support of an application are not released for other purposes and cannot be returned to the applicant.

Applicants to the Department of Health Administration are required to take the Graduate Management Admission Test, administered by the Educational Testing Service.

Students applying for financial aid in all departments should take the Graduate Record Examination no later than the October testing date in order to meet the 1 February deadline. Information on the times and places of the Graduate Record Examinations can be provided by the applicant's college or the Educational Testing Service, Princeton, New Jersey 08540, or Berkeley, California 94704.

Additional Procedures for Foreign Students. Fully qualified students from outside the United States are welcome to take courses in the Graduate School and, in many instances, to study toward a degree. In applying for admission the foreign student must, in addition to the information required of all students, submit with the application material (1) if the student's native language is not English, certification of English proficiency demonstrated by scores from the Test of English as a Foreign Language (TOEFL), administered through the Educational Testing Service in Princeton, New Jersey; and (2) a statement showing financial arrangements for the proposed term at Duke (estimated costs per calendar year are \$9,300[†]). A foreign student must meet all these requirements before the Graduate School will make any offer of admission.

All foreign students whose native language is not English will be tested during their first registration period for competence in the use of oral and written English. Until such competence is determined, admission and arrangements for an award involving teaching must remain provisional. Students found to lack necessary competence should be prepared to assume all costs for being tutored in English and should reduce their course or research programs by 3 units while being tutored. Students who do not successfully pass the test for competence in the use of oral and written English by the end of their first year of residency will not be permitted to continue their graduate work at Duke University. Passing this examination will not meet degree requirements for a foreign language. (See Language Requirements for Foreign Students.)

Notification of Status. When admission is approved, the student will receive a letter of admission and an acceptance form. The process of admission is *not complete* until the acceptance form has been returned. An admission offer is for the semester specified in the letter of admission.

Applicants who are admitted will be offered full admission, provisional admission, or nondegree admission. *Provisional admission* for a trial period of one semester or a minimum of 12 hours of course work is offered to students who appear to warrant admission but do not fully comply with admission requirements. Graduate credit earned under provisional status may be applied toward an advanced degree at Duke University if and when the student is granted full admission. *Nondegree admission* is offered to students who meet the admission requirements and who desire to engage in graduate study not subject to the restrictions of a graduate degree program. With the approval of the student's major

[†]Figures are based on 1978-1979 charges and are subject to change before the fall 1979 semester.



department and the Dean of the Graduate School, a maximum of 6 units of credit earned under nondegree status may be applied toward an advanced degree at Duke University if and when the student is granted full admission. (See ruling under the section on Master's Degrees in the chapter, Program Information.)

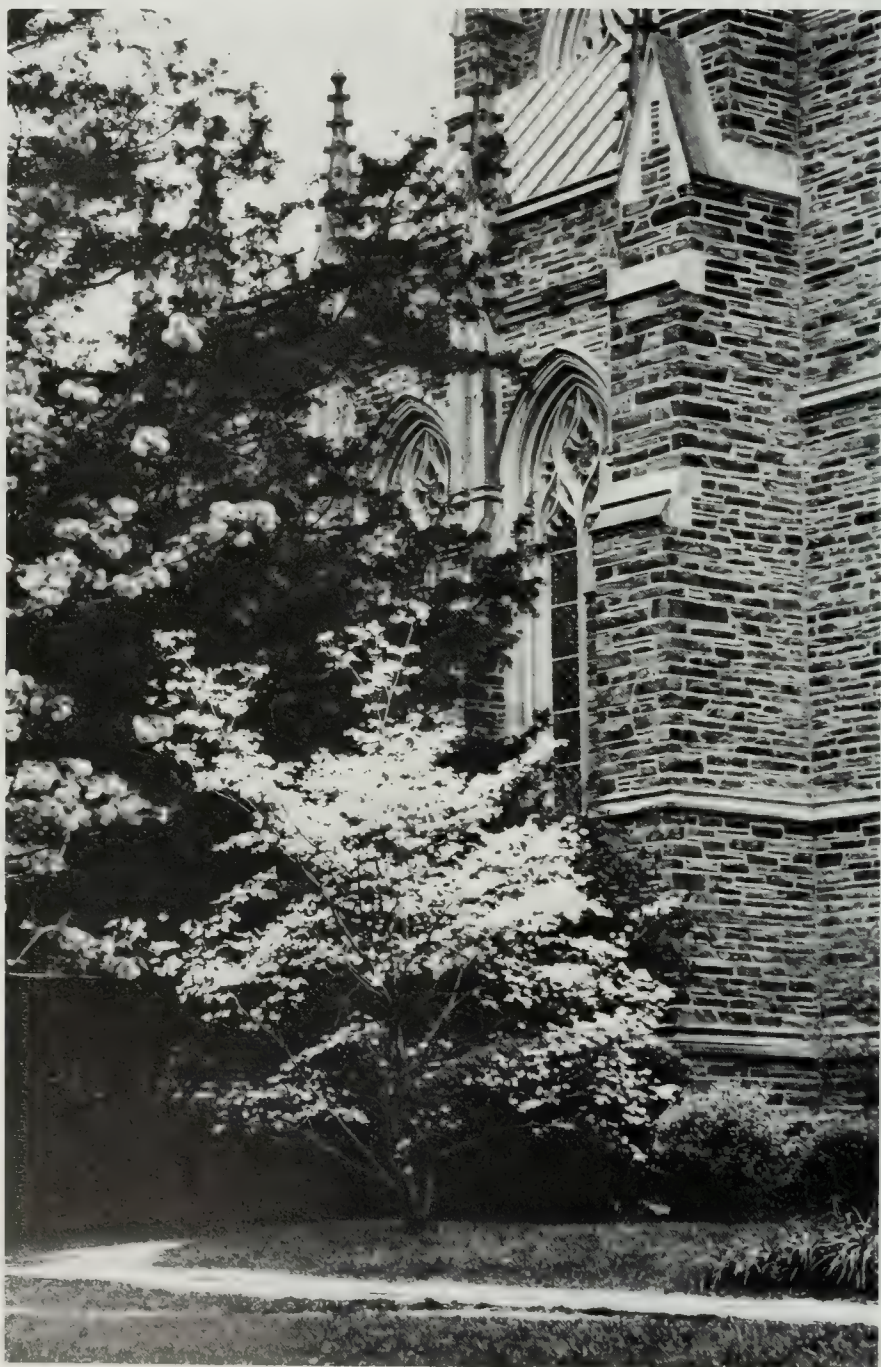
Deadlines for Application. It is the applicant's responsibility to make certain that the Graduate School office has received all required material before the specified deadlines. Because applications cannot be reviewed until all supporting documents are filed, applications should be submitted at least *two weeks* before the closing dates listed below:

Fall semester, admission and award	1 February
Fall semester, admission only	15 July
Spring semester, admission only	1 November
Summer session, 1979* first term	15 April
Summer session, 1979* second term	15 May
Summer session, 1979* third term	15 June

*Students seeking admission to the Graduate School for study in the summer session should make application to the Dean of the Graduate School as well as to the Director of summer programs.

Anyone whose folder is not complete before the appropriate date will face the possibility that departmental enrollment will have been filled. Although the Graduate School office will process all applications, it can not guarantee full consideration of a folder for any department after 15 April.

Financial Information



Tuition and Fees*

The 1979-80 tuition for all students (except those in health administration and physical therapy) for a full semester program is \$2,115 (15 units at \$141 per unit). Part-time tuition is calculated at the same rate of \$141 per unit. Tuition charges are due and payable at the times specified by the University for that semester and are subject to change without notice. Registration is not considered complete, and students may not be admitted to classes, until arrangements have been made with the Bursar of the University for the payment of tuition and fees. A late registration fee of \$25 is charged any student not completing registration during the registration periods. The *in absentia* fee is due on the date specified by the University and is subject to a late registration fee of \$10 if not paid by that date. The fee is \$141 for 1 unit per semester.

Students passing the preliminary examination may obtain a reduction in their registration and tuition fee at any time during the five-week period beginning on registration day. No other refund in fee may be obtained. A reduction in registration necessitated by changes in departmental service requirements for assistants may be made during the first two weeks of classes, with the approval of the Dean. Any fee reduction for this reason is credited to future registration fees. In the event of death or involuntary call to active military duty, refunds will be made on a pro rata basis. In all other cases of withdrawal, students or their parents may elect to have tuition and room and board charges refunded or carried forward as a credit for later study, according to the following schedule:

1. Withdrawal before classes begin: full refund;
2. Withdrawal during the first or second week of classes: 80 percent;
3. Withdrawal during the third, fourth, or fifth week of classes: 60 percent;
4. Withdrawal during the sixth week: 20 percent;
5. Withdrawal after the sixth week: no refunds.

Tuition or other charges paid from grants or loans will be restored to those funds, not refunded or carried forward.

Thesis or Dissertation Fees. Fees incurred in connection with thesis or dissertation are as follows:

*The figures contained in this section are projections and are subject to change prior to the beginning of the fall 1979 semester.

Binding fee, three copies of thesis or dissertation, other copies optional at \$5.50 per copy*	\$16.50
Microfilming fee, doctoral degree only, upon final submission	\$30.00
Copyright fee (doctoral degree only, optional)	\$20.00

*If more than one snap binder is required per copy of the dissertation, a deposit of \$4 will be collected for each additional snap binder.

Athletic Fee. An athletic fee of \$25 for the year is optional and payable in the fall semester. The Treasurer of the University has sole responsibility for collection of fees and for arranging for the proration of fees.

Special Tuition Rates for Employees. The Graduate School recognizes a special obligation to encourage the professional and personal advancement of employees.

The University grants reductions in tuition to eligible employees and eligible spouses enrolling in courses offered by the University providing the eligible individual is *not* taking courses for the purpose of attaining a degree. (1) Staff members and employees paid on the biweekly payroll are eligible for this benefit upon completion of one year of continuous service. (2) A staff member's spouse is eligible at the time the staff member becomes eligible while a faculty spouse becomes eligible at the time that the faculty member is eligible to participate in the Retirement Annuity Plan. (3) In the case of staff members or employees paid on the biweekly payroll, permission must be obtained from the employee's immediate supervisor that he or she will be excused from work during the time that the course is to be held (if during normal working hours). (4) Although the program may be used either for courses which are to be audited or for courses which are being taken for credit, the individual may *not* be enrolled as a degree candidate.

All individuals eligible for special tuition rates must meet the admissions standards required of all graduate students and must be admitted to the Graduate School. No more than two courses may be taken in any semester. The benefit is equal to one-half the regular course tuition charged.

Fee for Undergraduate Courses. Graduate students registering for undergraduate courses will be assessed 3 units for a nonlaboratory course and 4 units for a laboratory course.

Audit Fee. Registered students may audit without charge up to three courses per semester if they are registered for at least 15 units, or up to two courses per semester if they are registered for at least 9 units. Otherwise an audit fee of \$40 per course is charged.

Vehicle Fee. Each student possessing or maintaining a motor vehicle at Duke University shall register it at the beginning of the academic year in the security office at 2010 Campus Drive. A student who acquires a motor vehicle and maintains it at Duke University after academic registration must register it within five (5) calendar days after operation on the campus begins. Resident students are required to pay an annual fee of \$20 for each motor vehicle or \$10 for each two-wheeled motor vehicle. Resident students registering a vehicle for the first time after 1 January are required to pay \$14 for a motor vehicle or \$7 for a two-wheeled motor vehicle.

At the time of registration of a motor vehicle, the state vehicle registration certificate, a valid driver's license, and a student identification card must be presented.

If a motor vehicle or a two-wheeled motor vehicle is removed from the campus permanently and the decal is returned to the traffic office prior to 20

January, there will be a refund of \$10 for a motor vehicle and \$5 for a two-wheeled motor vehicle.

Transcript Fee. Students who wish to obtain copies of their academic records should direct requests to the Registrar's office. Ten days should be allowed for processing. A minimum fee of \$2, payable in advance, is charged for a single copy. When two or more copies are forwarded to a single address, a charge of fifty cents will be made for each additional copy.

The Student Health Fee. All students are assessed a fee for the Student Health Service. The fee is \$115 (\$57.50 each semester).

Debts. No records are released and no students are considered by the faculty as candidates for graduation until they have settled with the Bursar for all indebtedness.

Expenses*

Housing Fee. The fee for Town House Apartments, not including utilities, is \$865 per occupant for the academic year on the basis of three students to an apartment; for Modular Homes, \$1,113. Rates in Central Campus Apartments range from \$1,197 for two students in a one-bedroom apartment to \$1,938 for an efficiency apartment.

Housing fees are subject to change prior to the 1979-80 academic year. A \$50 deposit is required with all applications. No refund on housing fees is made to students who withdraw after the date of registration, except for those who withdraw involuntarily because of a call to active duty in the armed forces. Such refund will be made in accordance with the University's established schedules. For further information on housing facilities, see Living Accommodations in the chapter on Student Life.

Food. Food service on both the East Campus and the West Campus is described under Living Accommodations in the chapter on Student Life. The cost of meals is estimated at a minimum of \$5.20 per day, or about \$1,300 for the academic year, but depends upon the needs and tastes of the individual.

Summary. The table below represents an estimate of a graduate student's basic expenses for one academic year for a full program of work. These figures do not include allowances for recreation, travel, clothing, and other miscellaneous items which vary according to personal needs and tastes.

Tuition	\$4,230.00
Apartment Rent (Central Campus Apartments)	1,197.00
Board	1,300.00
Laundry	80.00
Books	250.00
Student Health Fee	115.00

Fellowships and Scholarships

James B. Duke Fellowships. The James B. Duke One-Hundredth Anniversary Fund provides fellowships for students who wish to pursue a program leading to the Ph.D. degree in the Graduate School at Duke University. Its objective is to aid in attracting and developing outstanding scholars at Duke. Selection of

*The figures contained in this section are subject to change prior to the beginning of the fall 1979 semester.

recipients is made by a faculty committee upon nomination by the appropriate department. It is expected that approximately forty offers of this fellowship will be made for the coming year. These fellowships provide for payment of tuition for full registration during the academic year, plus *in residence* registration during the summer sessions. They also provide an income stipend of \$350 per month for twelve months over the three-year duration of the award. The award requires no service and is renewable each year upon evidence of fellowship quality performance in progressing toward the degree. The total value of a James B. Duke Fellowship over the three years of tenure for a student who passes the preliminary examination at the end of the second year is over \$21,000 at current tuition rates. There are forty-six James B. Duke fellows currently enrolled.

Endowed Fellowships. Other special endowments provide fellowships for graduate study. The Angier B. Duke Fellowship provides support on the same level as the James B. Duke Fellowship for one student for the academic year. There are five Gurney Harris Kearns Fellowships in Religion ranging in value up to \$4,900. Selection for these fellowships is made through faculty committees. The E. Bayard Halsted Fellowship in science, history, or journalism is awarded to a graduate of Duke University intending to pursue an advanced degree at Duke. This fellowship, which is administered by the Graduate School, provides a monthly stipend plus tuition to an outstanding graduate student working in a broad area of science, history, or journalism. The Frank T. de Vyver Fellowship, administered by the Department of Economics, is awarded each year to an outstanding student entering the doctoral program in economics. The Clare Hamilton Memorial Endowed Fellowship, a gift of the Hamilton family in memory of their daughter, is awarded yearly on the basis of merit and need to one or more outstanding students in clinical psychology. The stipend of \$3,000 may be used to defray tuition and/or living expenses while the student is engaged in graduate study. Relatives and friends of the late Professor Charles R. Hauser established the Charles R. Hauser Fellowship to be awarded to an outstanding graduate student in the last year of work toward a Ph.D. degree in chemistry. The Department of Chemistry administers this fellowship, which is awarded to a student working in the area of organic chemistry. The Calvin Bryce Hoover Fellowship, established in honor of the late Professor Calvin Bryce Hoover, is administered by the Department of Economics and is awarded each year to an outstanding student entering the doctoral program in economics. The Robert R. Wilson Fellowship in the Department of Political Science is awarded to a student currently enrolled in, or entering, a doctoral program in international law, international organization, or international relations. This endowed fellowship is administered by the Department of Political Science. The Gertude Weil Fellowship, administered by the Department of Religion, is awarded to students interested in Judaic studies.

Graduate Fellowships. Graduate fellowships funded by Duke University are available to students in the Graduate School for study during the academic year. Stipends, which include tuition, range from \$4,230 for the academic year to \$7,600 for a full calendar year. In 1978–1979, eighty-four students held these fellowships.

Federal Fellowships.* Duke University participates in the following programs:

National Defense Education Act, Title VI Fellowships. The purpose of this program is to encourage persons to undertake advanced training in modern foreign languages and in related area studies not commonly taught in the United States. The world area in which National Defense Foreign Language (NDFL) Fellowships are offered at Duke University is South Asia. Fellows must engage in intensive study in a language of that world area during their tenure, as well as pursue work toward

*United States citizenship is generally a requirement for eligibility.

their degree. The fellowships carry an academic-year stipend of \$2,925, plus tuition. In 1977-1978, three students at Duke University held NDFL Fellowships. Interested persons should write to the International Studies Center.

National Science Foundation Fellowships. A number of students hold National Science Foundation Graduate Fellowships which provide tuition plus an income stipend of \$3,900.

Other federal programs support fellowships, traineeships, and research assistantships through departmental auspices. Approximately 400 students were supported through these programs during 1978-1979.

Fellowships in Medieval and Renaissance Studies. Three fellowships are awarded annually by the Duke University Committee on Medieval and Renaissance Studies. Fellows are chosen from among students enrolled in Ph.D. programs. They receive full tuition, plus a monthly stipend of \$300 for nine months, and may request two renewals of the appointment.

Special Fellowships. The following special fellowships are available to qualified Duke students from sources outside the University:

Shell Fellowships in African Studies. These fellowships are available to qualified students in social sciences who are preparing for careers in the State Department, including the foreign services of the United States, the United Nations, or other international agencies, or in research and teaching in international affairs in academic institutions within the United States. They must be citizens of the United States or residing permanently in the United States and intending to become citizens. The fellowships are intended to cover the expenses of field research in the preparation of doctoral dissertations. The stipend for each fellowship is \$4,000 plus a reasonable amount for transportation expenses. Inquiries should be made to the Administrative Assistant, Center for International Studies, 2101 Campus Drive, Durham, North Carolina 27706.

Cokesbury Graduate Awards in College Teaching. These awards are sponsored by the Board of Education of the Methodist Church. They are designed to assist graduate students who are committed to a Christian philosophy of higher education and who have been members of the Methodist Church for at least three years. Awards are for one year and vary in amount from \$500 to \$2,000. Applications must be completed before 1 April. Further information and application forms may be obtained from the Dean of the Graduate School.

Exchange Fellowships with the Free University of Berlin. These fellowships are available through an exchange arrangement with the Free University of Berlin which will provide fellowships for two graduate students to study during the regular



academic year in Berlin. Interested students should write to the Dean of the Graduate School prior to 1 February.

Special Graduate Fellowships for Minority Students. These fellowships provide for payment of tuition plus stipend for a total value of \$6,617. They are awarded for one year to qualified applicants upon the recommendation of the departments.

Departmental Fellowships. Various departments and schools within Duke University have fellowships which are available to students pursuing graduate study. Information may be obtained from the individual departments.

Graduate Scholarships. Graduate scholarships funded by Duke University are available to students in the departments of the Graduate School for study during the academic year. Awards are for full or partial payment of tuition; they range in value to \$3,810. In 1978–1979, eighty-one students held graduate scholarships.

Assistantships

Graduate Assistantships. Appointments as graduate assistants carry a total stipend of up to \$6,300 for the academic year. The value of the stipend is determined by the time spent in assisting, the qualifications of the assistant, and the nature of the work assigned. In 1978–1979, 181 students held graduate assistantships.

Research Assistantships. Appointments are for predoctoral candidates whose special training and qualifications enable them to serve as assistants to individual staff members in certain departments. Stipends may be up to \$6,300, depending on the nature of the assistance and the assisting time required. In 1978–1979, approximately 200 students held research assistantships.

Part-time Instruction. Several departments offering graduate work have exceptionally qualified graduate students work as part-time instructors, tutors, and teaching assistants. These students may qualify to reduce their registration to 9 or 12 units per semester.

Payment of Awards

The payment of income stipends to graduate students holding awards starts on 30 September and is made in nine equal payments on the last working day of each month thereafter.

Ordinarily, stipends awarded under fellowships, scholarships, and research assistantships are not subject to income or social security tax; however, a portion of the award to graduate assistants having teaching assignments may be subject to both. The Graduate School office will supply detailed information.

Loans

Students who anticipate a need to supplement their financial resources through loans or college work-study employment should obtain and complete a Graduate and Professional Student Financial Aid Service (GAPSFAS) form. These forms are available at most financial aid offices or from the Financial Aid Coordinator, The Graduate School, Duke University, Durham, North Carolina 27706. A student seeking a loan should contact his or her state lending agency. A list of state lending agencies with addresses is available upon request from the Graduate School.

It is the policy of the Graduate School to provide loans through the University to help students meet their educational expenses. Only students with full-time status who meet the federal criteria for need but who are unable to obtain a loan from their state agencies are eligible for loans. Loan funds are provided through the Federally Insured Student Loan Program, the National Direct Student Loan Program, and funds solely under institutional control. Generally, loans made from these funds, or in the case of loans from state agencies, bear no interest charge to qualified borrowers while they maintain student status and for a short period thereafter. Interest during the repayment period is at a generally favorable rate. The maximum amount of a loan through Duke for first year graduate students is usually limited to the amount of tuition. Proof of eligibility for state loans may be less demanding and more favorable to the borrower.

Inquiries concerning loans should indicate the department of intended matriculation and include all pertinent information concerning application to a state agency. These inquiries should be addressed to the Financial Aid Coordinator, Graduate School, Duke University, Durham, North Carolina 27706.

Work-Study Program Employment

Limited funds are available through the college work-study program for short-term or part-time employment of graduate students. Eligibility requirements are similar to those of the federal loan programs. These funds are also used in conjunction with the Graduate School summer work-study program which provides a limited number of qualified students doing research each summer with employment for four or more weeks. In addition to this program and to departmental employment opportunities, the placement office maintains a listing of employment openings for students.



Registration and Regulations



Registration

Who Must Register. All students who are enrolled in the Graduate School in any program and who have not been granted a leave of absence by the Dean must register each semester until all degree requirements are completed.

Registration Periods. After receiving notification of admission to the Graduate School and returning a statement of acceptance of admission, the student must register for the term indicated in the admission letter. A student first confers with the Director of Graduate Studies of the major department, who signs a course card listing the course work to be taken during the semester. The student then presents this course card to registration officials for enrollment in the selected courses. After the first registration, a student must register for subsequent semesters at the regular stated time for registration. Currently enrolled students who fail to register at the first scheduled registration period for the subsequent semester incur a penalty for late registration. A former student who has been on leave of absence and who intends to register to resume a degree program must give the department and the Dean notice of this intention two months before registration.

Late Registration. All students are expected to register at the times specified by the University. A late registration fee of \$25 is charged any student registering late, including a current student who delays registering until the special registration for new students.

Change of Registration. During the first *two weeks* of the semester, registration may be changed with the approval of the Director of Graduate Studies, if no reduction of fee is entailed. If fees are to be refunded, the approval of the Dean of the Graduate School is required. For the succeeding two weeks, courses may be dropped and equivalent hours of research or residence credit added with the approval of the Director of Graduate Studies, the instructor of the course, and the Dean. Students who pass the preliminary examination during the first five weeks of a semester may alter their registration with fee adjustments at any time during that period.

Academic Regulations

Residence.* Although graduate study consists principally of individual reading, research, and laboratory experimentation under guidance, academic

*See also section on Program Information.

progress in the United States is generally measured and recorded in terms of course hours and credits. Credit for courses, seminars, research, and residence, and corresponding tuition and fees are stated in terms of units. One unit is equivalent to one semester hour. The term *residence* designates full-time study and research in close proximity to the facilities provided, as opposed to part-time study incidental to a full-time occupation. For purposes of satisfying the residence requirement of the various degrees, residence of one year is defined as two successive academic semesters of no fewer than 9 units each semester. (See chapter on Study in the Summer for residence required of master's candidates engaged solely in summer study.) Each student must register for a full program until the preliminary examination is passed.

Faculty Ruling. No member of the instructional staff who is a candidate for a degree in the Graduate School of Duke University may hold a faculty rank above that of Instructor.

Course Load. Graduate students are considered fully registered when they enroll for the number of credits their programs require. Required registration is set in consideration of a student's obligation to teach or assist and of a student's progress toward fulfilling degree requirements. In the academic year normal registration for the resident doctoral student who does not hold an appointment as Part-time Instructor or Assistant and does not engage in part-time work, is 15 units a semester or 30 units an academic year. The registration for resident doctoral students who hold such appointments or undertake such work is either 12 units or a minimum of 9 units, depending upon the number of hours a week they are required to devote to such duties. Resident doctoral students carry full registration through the semester in which they pass the preliminary examination. If they remain in residence, they continue to register for a minimum of 3 units each semester until the dissertation is accepted. Those who elect to go out of residence



(away from the University) register for 1 unit each semester *in absentia* in order to keep their programs active.

The registration requirements for a resident student pursuing a master's degree are the same as those for a student pursuing the doctorate. A student who has completed all requirements except the thesis, and has not matriculated in a doctoral program at Duke, may register for as few as 3 units per semester. A student who decides to go out of residence (away from the University) registers for 1 unit *in absentia*. Regulations pertaining to a resident student enrolled in a master's program requiring no thesis are identical to those described above for doctoral students, up to and including the semester in which the course requirements are satisfied. At that point, the registration may be reduced to the number of units necessary for completion of the degree program, though no less than 3 units if the student is in residence.

In each term of the summer session, 6 units is the maximum registration. Students who are in residence during the academic year and wish to continue study and to use University facilities, including the Student Health Service, during the summer, must register for 1 unit in the first summer session term. This registration provides use of facilities for all three terms of the summer session.

The registration of 1 unit a semester *in absentia* provides occasional consultation with the thesis or dissertation supervisor. It may be waived for serious problems of health.



It is necessary to be a fully registered student according to the regulations listed above in order to establish eligibility for library carrel and laboratory space, student housing, University and some outside loans, and the Student Health Service, including accident and sickness insurance. (See the chapter on Student Life.)

Credits. The following regulations pertain to credits earned outside the Duke University Graduate School:

Graduate Credit Earned before the A.B. Degree is Granted. Ordinarily no credit will be allowed for graduate courses taken before a student has been awarded the A.B. or B.S. degree. However, an undergraduate student at Duke University, who at the beginning of the final semester lacks no more than three courses in order to fulfill the requirements of the bachelor's degree, may apply for admission to the Graduate School beginning that semester. If the student meets the requirements for admission, permission may be obtained from the Dean of the Graduate School to enroll for graduate courses to bring the total program to no more than five courses. In addition to undergraduate registration, the student must register in the Graduate School at the beginning of the semester in which graduate credit is to be earned in order for the courses to be credited toward a graduate degree program.

Transfer of Graduate Credits. Transfer of credit for graduate course work completed at another institution will be considered only after a student has earned a minimum of 12 units of graduate study at Duke University. After completing the 12 units, the student should file a request for transfer of credits on the appropriate Graduate School form.

Graduate Credit for Courses Taken in the School of Law. Upon recommendation of the Director of Graduate Studies, and approval of the Dean of the Graduate School, a student in the social sciences may take certain courses in the School of Law for graduate credit. In some instances, courses in the School of Law may be considered as fulfilling requirements for related work. To register for such courses, a student should present a letter from the Director of Graduate Studies in the major department to the Dean of the School of Law requesting permission to register for specific courses.

Reciprocal Agreements with Neighboring Universities. Under a plan of cooperation between Duke University and the University of North Carolina at Chapel Hill, North Carolina Central University in Durham, and North Carolina State University at Raleigh, students properly enrolled in the Graduate School of Duke University during the regular academic year, and paying full fees to this institution, may be admitted to a maximum of two courses per semester at one of the other institutions in the cooperative plan. Under the same arrangement, students in the graduate schools in the neighboring institutions may be admitted to course work at Duke University. Courses may be taken only at the main campuses of the cooperating universities under this arrangement. All interinstitutional registrations involving extra-fee courses or special fees required of all students will be made at the expense of the student and will not be considered a part of the Duke University tuition coverage.

Identification Cards. Graduate students are issued two-part identification cards which they should carry at all times. The cards are the means of identification for library privileges, athletic events, and other University functions or services open to them as University students. Students will be expected to present their cards on request to any University official or employee. The cards are not transferable, and fraudulent use may result in loss of student privileges or suspension. A student should report the loss of a card immediately to the Registrar's office. The cost of a new ID card is \$5.

Grades. Grades in the Graduate School are as follows: *E*, *G*, *S*, *F*, and *I*. *E* (exceptional) is the highest mark; *G* (good) and *S* (satisfactory) are the remaining passing marks; *F* (failing) is an unsatisfactory grade; and *I* (incomplete) indicates that some portion of the student's work is lacking, *for an acceptable reason*, at the time grades are reported. The instructor who gives an *I* for a course specifies the date by which the student must make up the deficiency, in no case more than one calendar year from the date the course ended. If the course is not completed, the grade of *F* is normally entered upon the student's record. The grade of *Z* indicates satisfactory progress at the end of the first semester of a two-semester course. A grade of *F* in a major course normally occasions withdrawal from a degree program not later than the end of the ensuing semester or term; a grade of *F* in any other course occasions academic probation.

Courses Primarily for Undergraduates. Students granted provisional admission and others whose preparation is found deficient may occasionally be required, as part of their programs, to take undergraduate courses as prerequisites to continued graduate study. Undergraduate courses thus taken and others elected by the student carry no credit toward a degree.

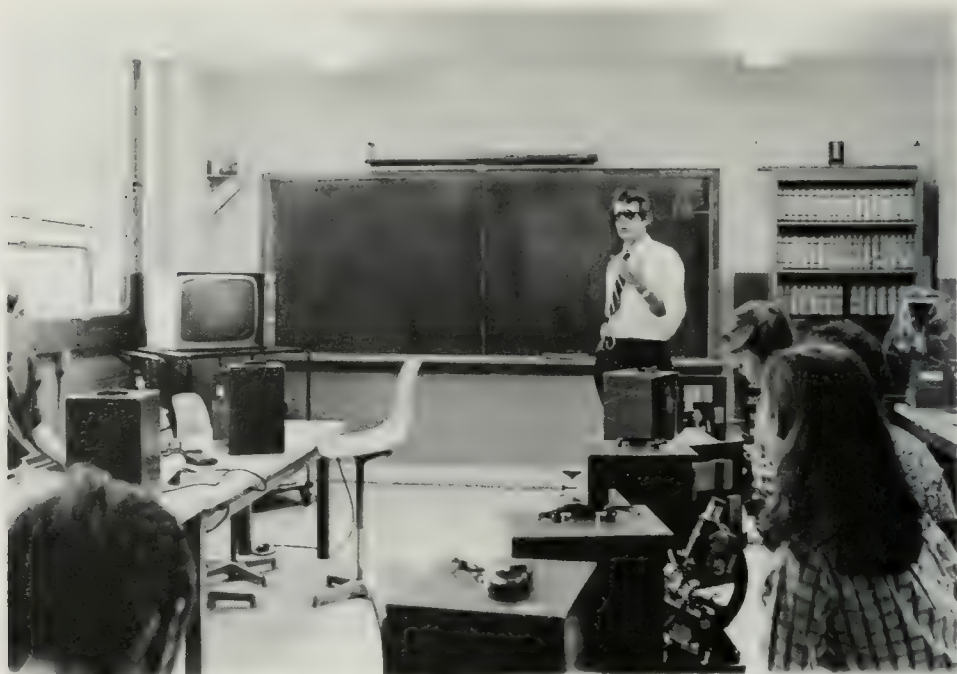
In exceptional cases, 100-level courses outside the major department may be taken for degree credit to a maximum of two one-semester courses or one year course not exceeding a total of 8 units, when approved by the Director of Graduate Studies in the major department and in the department in which the course is listed, and by the supervisor of the program. In order to receive credit for any such undergraduate work, the graduate student must earn a grade of at least *B*. Graduate students registering for undergraduate courses will be assessed 3 units for a nonlaboratory course and 4 units for a laboratory course.

Withdrawal from a Course. For permissible changes during the first four weeks of a semester, see Change of Registration. If a course is dropped without the necessary approval, the permanent record will list the course as *Dropped Unofficially, F*. If a course is dropped after the four-week period, the status of the student at the time of withdrawal from the course will be determined and indicated on the permanent record as *Withdrew Passing (WP)* or *Withdrew Failing (WF)*.

Interruption of Program and Withdrawal from the Graduate School. The University reserves the right, and matriculation by the student is a concession of this right, to request the withdrawal of any student whose academic performance at any time is not satisfactory to the University. A student who wishes for any reason to withdraw from the Graduate School should notify in writing both the Director of Graduate Studies in the major department and the Dean of the Graduate School prior to the date of the expected withdrawal. (For refunds upon withdrawal, see the section on Tuition and Fees.)

A student who, after successfully completing one semester of graduate study, must withdraw before completion of a graduate program may, with the approval of the major department, request the Dean to issue a certificate of graduate study.

Leave of Absence. A leave of absence for a period of time no longer than one calendar year may be granted because of medical necessity, full-time employment at Duke University, or acceptance of an external award judged likely to benefit the student as an individual but not related to the degree requirements. A request for a leave of absence should be originated by the student, endorsed by the student's major professor and Director of Graduate Studies, and submitted to the Dean of the Graduate School for consideration. A student is eligible to request a leave of absence only after having completed at least one semester at Duke. Time limitations which pertain to the various degrees and the completion of courses on which a grade of *I* (incomplete) was earned are not waived.



Size and Make-up of Classes. Classes which carry graduate credit are limited in size to thirty students. In exceptional cases this regulation may be modified, but only by permission of the Dean of the Graduate School. Courses numbered from 200 through 299 may have not only graduate students enrolled, but also an unspecified number of sophomores, juniors, and seniors, provided the undergraduates have the approval of both the instructor of the course and the Director of Graduate Studies. Undergraduate students are not permitted to enroll in 300- or higher level courses.

Language Requirements. Although individual departments have the right to establish their own minimal requirements (see individual departmental sections in this bulletin), the regulations of the Graduate School require no language for the master's degree, and, in many departments, a reading knowledge of one foreign language, ancient or modern, for the Ph.D. degree. With the special approval of the Dean and of the Executive Committee of the Graduate Faculty, the foreign language requirement for the Ph.D. degree may be waived in individual cases or with respect to all students in a given department, provided the department submits satisfactory evidence that a foreign language has little bearing on the major program of the students concerned. The languages usually taken are French, German, and Russian. A student may substitute another language which has a definite relation to the degree program and for which an examination can be provided. A foreign student whose native language is not English may request that the Director of Graduate Studies in the major department ask permission of the Dean of the Graduate School to offer English for the foreign language required for the degree.

To avoid unnecessary delays, prospective students should anticipate the language requirement of their degree programs. For example, a student whose program requires a knowledge of French, German, Russian, or Spanish is urged to take the appropriate Educational Testing Service (ETS) Graduate School Foreign Language Test prior to registration. It should be noted, however, that at the time of

the final examination in a master's program or of the preliminary examination in a doctoral program, language examinations more than six calendar years old will not be accepted toward fulfilling the language requirement.

Meeting the Requirement. The foreign language requirement may be satisfied in the following ways:

1. The student may take one of the ETS examinations administered to undergraduate and graduate students at many national centers (including Duke University Counseling and Psychological Services). The examination may be taken no earlier than six years before the preliminary examination.
2. With the permission of the Dean of the Graduate School, the Director of Graduate Studies may request acceptance of a language examination passed prior to the student's enrollment at Duke. The student should request that a transcript or other certification that the language examination was passed be sent to the Graduate School for approval. Requirements are (a) that only one language of a doctoral requirement be met in this way, (b) that the other institution offer a doctoral program in the student's major and the examination would have met a doctoral requirement there, and (c) that the examination have been passed no more than five years before first registration at Duke.
3. In a language for which ETS tests are not available, a reading examination may be arranged by the Graduate School office and administered by a qualified examiner.
4. In special circumstances, a reading examination in any foreign language may be administered by a qualified member of the faculty under a procedure specified by a department and approved by the Dean and the Executive Committee of the Graduate Faculty.

Requirements for Foreign Students. Foreign students whose native language is not English are, during their first registration period, required to take a test for minimum competence in English. Such students, with the approval of the Director of Graduate Studies in their major department, may request permission of the Dean of the Graduate School to substitute English for the one foreign language required in the master's or doctoral program. (See Admission Procedures for Foreign Students.)

Special Language Courses. Special courses designed to assist graduate students in acquiring a reading knowledge of French or German are offered for three hours a week. Students who register for such a course must reduce their normal load of graduate courses by 3 units, with no reduction in fees. Special language reading courses carry no credit toward a degree. Auditors are not permitted in these courses. Undergraduates may not enroll in these special courses during the academic year but may register in the summer with permission of the Dean of the Graduate School, provided space is available after graduate students have been enrolled.

Undergraduate Language Courses. Graduate students receive no credit for language courses numbered below 200.

Commencement

Graduation exercises are held once a year, in May, when degrees are conferred on, and diplomas are issued to, those students who have completed requirements by the end of the spring semester. Those who complete degree requirements by the end of the fall semester or by the end of a summer term receive diplomas dated 30 December or 1 September, respectively. There is a delay of about one month in the

mailing of September and December diplomas because diplomas cannot be issued until they are approved by the Academic Council and the Board of Trustees.

Standards of Conduct

Duke University expects and will require of all its students cooperation in developing and maintaining high standards of scholarship and conduct.

The University wishes to emphasize its policy that all students are subject to the rules and regulations of the University currently in effect or which, from time to time, are put into effect by the appropriate authorities of the University.

Judicial Code and Procedures. In the spring of 1971, the Graduate School community ratified and adopted the following official judicial code and procedures:

I. Graduate School Judicial Code and Procedures

A. A student, by accepting admission to the Graduate School of Duke University, thereby indicates his willingness to subscribe to and be governed by the rules and regulations of the University as currently in effect or, from time to time, put into effect by the appropriate authorities of the University, and he indicates his willingness to accept disciplinary action, if his behavior is adjudged to be in violation of those rules or in some way unacceptable or detrimental to the University. However, a student's position of responsibility to the authorities and the regulations of the University in no way alters or modifies the responsibilities that are his in relation to civil authorities and laws.

B. A graduate student at Duke University stands in a primary and unique relation of responsibility to the faculty in his major department, the faculty upon whose recommendation a graduate degree will or will not be awarded to the student. In matters which involve or may affect the student's intellectual or professional life, the student is directly responsible to this department and its representatives, and such matters should primarily be handled by the department.

C. Actions which appear to conflict with University-wide rules and regulations will fall under the jurisdiction of the University Judicial Board.

D. A student may elect to have the Dean of the Graduate School hear matters related to the student's conduct in addition to or instead of faculty members from the student's major department, or he may elect to have such matters reviewed and judged by a judicial board instead of the Dean of the Graduate School or members of the faculty in his major department. (The constitution and procedure of the judicial board are detailed below).

E. The Director of Graduate Studies in the student's major department may request that a student's actions be reviewed by the Judicial Board or by the Dean of the Graduate School.

II. The Graduate School Judicial Board

A. *Composition.* The Graduate School Judicial Board shall have five members, serving for a period of two years: two students selected from the student body, two members of the Graduate Faculty appointed by the Executive Committee of the Graduate School, and one Associate or Assistant Dean appointed by the Dean of the Graduate School. The Board shall elect one of its members as Chairman. The Board shall have at its service a recording secretary to keep minutes of the hearings and of the Board's actions in a permanent, confidential record book. The Board will be constituted in order to hear cases in which the accused is a student currently enrolled in the Graduate School and which have been referred to it by the Director of Graduate Studies in the student's department, by the Dean of the Graduate School, or by the student himself.

B. *Preliminary Procedures.* If a student requests a hearing by the Judicial Board he must do so in writing, allowing its Chairman at least 72 hours to convene the Board. In addition, the Chairman shall not convene the Board until 72 hours after he has been asked to convene the Board. It is the responsibility of the Chairman of the Judicial Board fully to inform its members concerning the case and the reasons the case has been referred to the Board. In addition, he shall prepare a written summary of this information for the Board, the Dean, and the student.

C. *Procedural Safeguards for the Hearing.* The Accused has the right to challenge any member of the Judicial Board on grounds of prejudice. If the Board decides to excuse one or more of its members for reasons given by the Accused, it shall consult with the Dean about the need for replacements. The Accused may choose an Advisor to assist him in his defense. He may also produce witnesses (including no more than two character witnesses), introduce documents, and offer testimony in his own behalf. A person having direct knowledge relevant to a case being heard by the Board is a material witness. The Judicial Board may request the appearance of material witnesses. The Board shall also request, upon written request of the Complainant or the Accused, the appearance of material witnesses. Witnesses shall be notified of the time, place, and purpose of their appearance. The Accused has the right to examine the written statement of any witness relevant to his case at least 72 hours before the hearing.

He has the right to be faced with any witness who has given a statement relevant to his case at the hearing if the witness's attendance can be secured.

The hearing will be conducted in private unless the Accused requests an open hearing. If any objection is raised to conducting an open hearing in any particular case, the Judicial Board shall decide the issue by majority vote. If the decision is made not to hold an open hearing, the Accused shall be informed in writing of the reasons for the decision.

The Judicial Board shall consider only the report of the Chairman, documents submitted into evidence, and the testimony of witnesses at the hearing in reaching its decisions.

D. Conduct of the Hearing. The hearing of any case shall begin with a reading of the charge by the Chairman in the presence of the Accused. The Accused shall then plead guilty or not guilty or move to terminate or postpone the hearing. The Accused may qualify a plea, admitting guilt in part and denying it in part. The Accused may not be questioned for more than one hour without recess.

At any time during the hearing, the Accused or the Judicial Board may move to terminate or to postpone the hearing or to qualify his plea or to modify its charge.

Pending verdict on charges (including appeal) against the Accused, his status as a student shall not be changed, nor his right to be on campus or to attend classes suspended, except that the Chancellor or Provost may impose an interim suspension upon any member of the University community who demonstrates, by his conduct, that his continued presence on the campus constitutes an immediate threat to the physical well-being or property of members of the University community or the property or orderly functioning of the University.

E. Sanctions and the Verdict. The Graduate School Judicial Board shall have the power to impose the following penalties: expulsion, dismissal from the University with the recommendation that the person never be readmitted; Suspension, dismissal from the University and from participation in all University activities for a specified period of time, after which the student may apply for readmission; Disciplinary Probation, placing the student on a probationary status for a specified period of time, during which conviction for violation of any regulation may result in more serious disciplinary action; Restitution, payment for all, or a portion of property damage caused during the commission of an offense. Restitution may be imposed by itself or in addition to any of the other penalties. The Judgment shall consist of a finding of guilty or not guilty of the charge and, when the Accused is found guilty, a statement of the punishment assessed. On all questions, including the verdict and the finding of guilty or not guilty, the Board shall be governed by a majority vote. The Judicial Board may decide to rehear a case in which significant new evidence can be introduced. In addition, the defendant may request an appeal.

F. Appeals. The appellant may submit to the Dean a written statement containing the grounds for his appeal and his arguments. In such cases, the Dean should determine if the appeal should be granted, and he can hear the case himself, or refer it to the appropriate faculty in the student's department or to the Judicial Board.

An appeal shall be granted on the following grounds: procedural error substantially affecting the rights of the accused; incompatibility of the verdict with the evidence; excessive penalty not in accord with "current community standards"; new evidence of a character directly to affect the judgment but on which the original tribunal had refused a new hearing.

III. Amendment and Construction

This Judicial code and procedure and this constitution and procedure for the Graduate School Judicial Board may be amended at any time with due notice or publication by consent of the Dean, the Executive Committee, and the graduate students. Questions and problems not answered or anticipated by the foregoing may be resolved by the use of other existing institutions or by amendment.

Study in the Summer



Programs Offered

The 1979 summer session of Duke University will consist of three terms. The first term will begin on 8 May and will end on 11 June; the second term will begin on 11 June and will end on 13 July; and the third term will begin on 16 July and end on 17 August. A graduate student who wishes to work toward an advanced degree in the summer session, particularly in chemistry, economics, education, English, history, mathematics, religion, sociology, and zoology, will find a selection of courses offered by members of the Duke faculty and by visiting professors. Other departments ordinarily offering work leading to the A.M. degree are botany, political science, and psychology. Thesis research for advanced graduate students is available also in most other departments, such as engineering, forestry, and physics.

A student wishing to be admitted to the Graduate School for work in the summer session should make application to the Dean of the Graduate School, as well as to the Director of Summer Educational Programs, and should return the completed application, with supporting documents, before 15 April for admission to Term I; before 15 May for admission to Term II; and before 15 June for admission to Term III. (See the chapter on Admission.)

Regulations Regarding Summer Work

No graduate student may register for more than 6 units of credit in one summer session term. All work required for the master's degree must be completed within six years of the date of matriculation. No residence credit can be accepted toward the requirement for the Ph.D. degree for work completed during the summer sessions. A student who completes, during the summer session, the work required by the University for an advanced degree will be granted the degree in September.

The *Bulletin of Summer Educational Programs* containing information about graduate courses, may be obtained by writing to the Director of Summer Educational Programs, Duke University, Durham, North Carolina 27706.

Courses of Instruction



Course Enrollment

In general, courses with odd numbers are offered in the fall semester, those with even numbers in the spring semester. Double numbers separated by a hyphen indicate that the course is a year course and usually must be continued throughout the year if credit is to be received. A student must secure written consent from the instructor in order to receive credit for either semester of a year course. Double numbers separated by a comma indicate that although the course is a year course, credit may be received for either semester without special consent. Ordinarily, courses which bear no date are offered every year.

Note: In each department the number 399 is reserved to designate special (individual) readings in a specified area and supervised by a regular member of the graduate staff, with credit of 1-3 units each registration, only one course per registration, and 9 units maximum in three successive registrations. The course is restricted to resident master's and doctoral programs, must have a completion exercise, and must carry a grade.

Anatomy

Professor Robertson, *Chairman* (466 Sands); Professor Hall, *Director of Graduate Studies* (250 Sands); Professors Moses and Counce; Professor Emeriti Everett and Peele; Associate Professors Cartmill, Erickson, Hall, Hylander, Kay, Longley, and Reedy; Assistant Professors Adelman, Cant, Corless, Costello, Jakoi, Marchase, McIntosh, Schachat, Strickler, and Tyrey; Lecturer Diamond; Adjunct Professor Simons

The Department of Anatomy offers graduate programs designed to produce teachers and research workers competent in a broad range of anatomical sciences; A.M. and Ph.D. degrees are offered. Students with a wide variety of backgrounds and interests in the biological sciences can be accommodated. All students participate in a core of anatomical science courses (Anatomy 305, 307, 309) and gain experience in teaching over the range of departmental interests. Students are encouraged to round out their formal course work by drawing upon the offerings of other departments in the University, as well as those in the anatomy department. Laboratories within the department are equipped for and actively support research in several areas. Some idea of the opportunities for degree research may be gleaned from the description of Anatomy 312. For further information contact the Director of Graduate Studies.

207. Human Anatomy. A lecture-laboratory-discussion course that examines human morphology and the fundamental relationships among the neurologic,

musculo-skeletal, cardiovascular, gastrointestinal, respiratory, renal, and reproductive systems. The course includes cadaveric presentations of every major region of the human body. Intended primarily for students in allied health programs. Prerequisite: consent of instructor. Credit to be arranged; maximum 3 units. *Staff*

208. Anatomy of the Trunk. Designed for Ph.D. candidates in anatomy as well as general practitioners and specialists in surgery and internal medicine. Emphasis upon the anatomy of the thoracic, abdominal, and pelvic organs. Prerequisite: core course in anatomy. Enrollment: number of students to be arranged by staff. 2 units. *Duke*

214. Anatomy of the Head and Neck. This course is designed to be a review of the head and neck, emphasizing its phylogenetic and ontogenetic development along with clinically important features of the anatomy of this region. Prerequisite: Anatomy 305. 2 units. *T. Strickler*

215. Contractile Processes. (Also listed as Physiology 216.) Offered in 1979 and alternate years. 3 units. *Johnson, Anderson, or Jöbsis*

216. Biological Psychology. (Also listed as Psychology 216.) 3 units. Spring. *Diamond*

217. Structure and Function of Visual Photoreceptors. A detailed study of available structural, biochemical, spectroscopic, and physiological data from retinal photoreceptors. Emphasis on molecular structure of vertebrate photoreceptor membranes, effects of bleaching on rhodopsin molecule, and initiation of neural information after photon absorption. Lectures, seminars, and demonstrations. Complements Anatomy 276. Offered fall, 1979, and alternate years thereafter. Prerequisite: consent of instructor. Credit to be arranged; maximum 4 units. *Corless*

219. Molecular and Cellular Bases of Development. A multidisciplinary approach stressing the molecular, cellular, and genetic processes involved in development and differentiation in prokaryotes and eukaryotes. Topics include: initiation of development, morphogenesis, developmental genetics, differentiation, and nuclear-cytoplasmic interactions in development. (Also listed as Biochemistry 219, Microbiology 219, Pathology 219, and Physiology 230.) Fall. 3 units. *Padilla and staff*

219S. Seminar. Optional seminar offered in conjunction with Anatomy 219. Students prepare and present seminar topics directly related to specific subjects discussed in Anatomy 219. Prerequisites: enrollment in Anatomy 219 and consent of instructor. 1 unit. *Staff*

231. Human Evolution. Evolutionary biology of the primates. Anatomical and behavioral adaptations and phylogeny of fossil and living primates including *Homo sapiens*. Prerequisite: Anthropology 93 or equivalent. 3 units. *Cartmill*

238. Functional and Evolutionary Morphology of Primates. History and functional significance of locomotor and feeding adaptations, craniofacial morphology, sense organs, and reproductive systems in primates, including *Homo sapiens*. Prerequisite: Anatomy 231, or equivalent, or consent of instructor. Offered spring, 1979, and alternate years thereafter. (Also listed as Anthropology 245.) 3 units. *Hylander and Cartmill*

240. Mechanisms of Biological Motility. Discussions, based on extensive readings, on the ultrastructure and biochemistry of biological motile systems. Introductory discussions of muscle contraction and sperm-cilia-flagella will form

the basis for subsequent consideration of such weekly topics as amoeboid motion, fibroblast motility, protoplasmic streaming, mitosis, particle saltations, etc. Emphasis placed on defining similarities between systems with different phenomenologies of motion. Ends with a series of brief student seminars on topics from areas not covered in the principal seminars. Prerequisite: written consent of instructor. Enrollment: minimum 4; maximum 10. 3 units. *Adelman*

246. The Primate Fossil Record. Offered spring, 1978, and alternate years thereafter. (Also listed as Anthropology 246.) 3 units. *Kay*

261. History of Generation and Mammalian Reproduction. Theories of generation and of historical development of present-day concepts of mammalian reproductive processes. Prerequisite: consent of instructor. Offered fall, 1979, and alternate years thereafter. (Alternates with Anatomy 263.) 1 unit. *Duke*

263. History of Anatomy. The lives and contributions of the founders of anatomy, Aristotle to the twentieth century. Prerequisite: consent of instructor. Offered fall, 1978, and alternate years thereafter. (Alternates with Anatomy 261.) 1 unit. *Duke*

264. Mammalian Embryology and Developmental Anatomy. Study of early embryology and organology of mammals, using the rat as the basic form and supplementing it with other mammalian forms, including primates. Prerequisites: one year of zoology and consent of instructor. Offered spring, 1980, and each spring thereafter. 4 units. *Duke*

265S, 266S. Seminar in Chromosome Biology. Current research in chromosome structure and function, mitosis, and meiosis. Prerequisites: a course in cell biology or genetics, and consent of instructor. (Also listed as Zoology 265S, 266S.) 2 units each semester. *Moses (anatomy) and Nicklas (zoology)*

276. Neuroanatomical Basis of Sensory Physiology. Original papers read and discussed which are concerned with the neuroanatomical substrates underlying sensory processing in the auditory and visual systems. Prerequisite: consent of instructor. Offered spring, 1979, and alternate years thereafter. (Also listed as Psychology 276.) 3 units. *Hall*

280. Structure and Assembly of Macromolecules. Lectures and conferences on the structure of biological macromolecules and on the mechanisms of assembly of organized macromolecular aggregates such as are found in viruses and cellular organelles. Emphasis on the results of electron microscopic, X-ray diffraction, and optical analyses. Prerequisites: microscopic anatomy or cytology, or equivalent, and consent of instructor. Offered spring, 1979, and alternate years thereafter. (Alternates with Anatomy 286.) 3 units. *Longley, Corless, Erickson, Moses, Reedy, and Robertson*

286. The Light Microscope, the Electron Microscope, and X-ray Diffraction in Biology. Lectures and laboratories on methods of ultrastructure research. Fundamentals of optics; the light microscope, phase, polarizing, and interference microscopy. Basics of electron microscopy, staining, sectioning, and replication techniques. Optical and computer image processing. Introduction to X-ray diffraction theory and apparatus in structure determination. Prerequisites: microscopic anatomy or cytology, or equivalent; calculus; one year each of physics and general chemistry; consent of instructor. Offered spring, 1978, and alternate years thereafter. (Alternates with Anatomy 280.) 4 units. *Longley, Corless, Erickson, and Reedy*

288S. The Cell in Development and Heredity. A seminar on topics of current interest and controversy. Prerequisites: a course in genetics and consent of

instructor. Offered spring, 1979, and alternate years thereafter. (Also listed as Zoology 288S and under the University Program in Genetics.) 2 units. *Counce*

299. Neuroanatomical Basis of Behavior. Basic neuroanatomy and its physiologic and functional correlates. 3 units. *Hall*

300. Gross Anatomy. Gross anatomy for physical therapy students. Credit to be arranged; maximum 8 units. *Staff*

305. Gross Human Anatomy. Includes complete dissection of a cadaver; laboratory work is supplemented by conferences which place emphasis upon biological and evolutionary aspects. Prerequisites: adequate background in biology, including comparative anatomy and embryology; written consent of the Director of Graduate Studies. Required of entering graduate students in anatomy; by arrangement, may extend into second semester. 3 units. *Staff*

307. Microscopic Anatomy. Emphasis on the cell, its generalized structural and functional organization down to the molecular level, and differentiations of the cell in various organs and tissues. Introduction to light and electron microscopic and diffraction methods for investigating biological structure. Prerequisites: adequate background in biology, including comparative anatomy and embryology; written consent of the Director of Graduate Studies. Required of entering graduate students in anatomy; by arrangement, may extend into second semester. 3 units. *Staff*

309. Neuroanatomy. Gross and basic intrinsic anatomy of the central nervous system. Later, specific systems will be emphasized; various sensory and motor, limbic-hypothalamic, and cerebral-associated mechanisms. Clinical presentations will be offered. Prerequisites: adequate background in biology, including comparative anatomy and embryology; written consent of the Director of Graduate Studies. Required of entering graduate students in anatomy; by arrangement, may extend into second semester. 2 units. *Staff*

312. Research. Individual investigations in the various fields of anatomy. Laboratories in which a student may work include: three electron microscopy laboratories headed by Moses, Reedy, and Robertson with emphasis respectively on the fine structure and cell biology of chromosomes and associated structures, molecular structure and function of muscle, and biophysical studies of cell membranes and nervous tissue; physical anthropology laboratories and the primate facility under Simons, Cartmill, Hylander, and Kay concentrating on biomechanics, cytogenetics, comparative anatomy, and primate evolution and behavior; neuroanatomy laboratories under Peele, Hall, and Diamond emphasizing structural correlates of behavior and learning; neuroendocrinology laboratories under Everett and Tyrey with emphasis on brain mechanisms regulating reproductive functions of the pituitary gland; comparative anatomy laboratory under Duke focusing on ovarian structure and function; a functional vertebrate morphology laboratory under Strickler emphasizing morphology and behavior of bats; developmental biology laboratories under Counce with emphasis on insect and amphibian morphogenesis and the role of cell membrane contact phenomena in differentiation; a cell biology laboratory under Adelman studying the biochemistry and phenomenology of primitive motility; and molecular structure laboratories under Longley, Erickson, and Corless using a combination of electron microscopy, X-ray diffraction, and optical and computer methods of image analysis to study respectively fibrous proteins, microtubules, and photoreceptor membranes. Prerequisite: consent of instructor. Credit to be arranged; maximum 6 units. *Staff*

313, 314. Anatomy Seminar. Regular meeting of graduate students and staff in which current research problems in anatomy will be presented. 1 unit each semester. *Staff*

340. Tutorial in Advanced Anatomy. Topics for intensive reading and discussion will be chosen according to the student's interests, related to basic problems in biophysics, cytology, endocrinological control, growth and development, neuroanatomy, physical differentiation, and evolutionary origins of functional microsystems. Prerequisite: consent of instructor. Enrollment: maximum 8. 3 units. *Staff*

344. Advanced Neuroanatomy of Sensory and Motor Mechanisms. The course will involve consideration of classic and modern concepts of somatic and special sensory systems and of somatic and visceral motor systems. Clinical correlations of basic neuroanatomy will be included. Enrollment: minimum 5; maximum 20. 3 units. *Peele*

354. Research Techniques in Anatomy. A preceptorial course in various research methods in anatomy. An interested student might engage in research in one of the following: anthropology, electron microscopy, X-ray diffraction, chromosome analysis, developmental biology, fetal physiology, primate behavior, primate anatomy, and stereotactic approaches to neuroendocrinology and neuroanatomy. Other topics may be arranged. Prerequisite: consent of instructor. Credit to be arranged. *Staff*

418. Reproductive Biology. See course description for Physiology 418. (Also listed as Physiology 418.) 2 units. *Anderson, Schomberg, and Tyrey*

Anthropology

Professor Fox, *Chairman* (03 North); Associate Professor Quinn, *Director of Graduate Studies* (020 North); Professor Emeritus La Barre; Professors Friedl and Simons; Associate Professors Apte, Cartmill, Hylander, Kay (anatomy), O'Barr, Smith, Stack (public policy sciences); Assistant Professors Glander, Graedon (School of Nursing), Hammond, and Pessar

The department offers graduate work leading to the Ph.D. degree in anthropology. Applicants for admission should submit scores on the Graduate Record Examination Aptitude Test. Admission to the program is not contingent on previous anthropological course work or any other specific program of study at the undergraduate level.

Candidates for the Ph.D. degree must demonstrate knowledge of the broad issues and perspectives that unify anthropology, and competence in their chosen subfield of specialization. The department offers a program of specialization in social/cultural anthropology and a program of specialization in physical anthropology. The emphasis of the social/cultural anthropology program is the application of a cross-cultural and comparative perspective to research in complex societies. The emphasis of the physical anthropology program is primate evolution; areas of concentration include comparative morphology of human and nonhuman primates, and primate social behavior.

Curriculum is tailored to the individual student's specific background, needs, and research goals; relevant cross-disciplinary study is encouraged. However, there is a modest number of required courses for students in both programs. All students must participate in Anthropology 291 and 330-331 (on the evolution of human society) and demonstrate competence in statistics and at least one foreign language. In addition, students in the physical anthropology program must complete Anthropology 244, 246, and 305, or acceptable course substitutions.

Further details of the graduate program in anthropology, the departmental facilities, the staff, and various stipends available are described in the *Guidelines for Graduate Students in Anthropology* which may be obtained from the Director of Graduate Studies, Department of Anthropology.

For Seniors and Graduates

211S. Ethnography of Communication. Verbal and nonverbal communication from the sociolinguistic perspective. Emphasis on synchronic and diachronic aspects of communication as related to the development of sociolinguistic theory. Prerequisite: Anthropology 107 or consent of instructor. 3 units. *Apte or O'Barr*

220S. Society and Culture in India. The basic features of Indian cultures and societies from an anthropological perspective. The impact of selected technological and social changes upon the individual, caste, and community. Prerequisite: Anthropology 94, or consent of instructor. 3 units. *Apte or Fox*

222. Topics in African Anthropology. Research problems illustrated through ethnographic studies of African societies. Topic will change each semester. 3 units. *O'Barr*

234S. Political Economy of Development: Theories of Change in the Third World. Alternative approaches to political, economic, and social change in Latin America, Africa, and Asia. (Also listed as History 234S, Political Science 234S, and Sociology 234S.) 3 units. *Bergquist, Pessar, Portes, Smith, and Valenzuela*

242S. Topics in Prehistory. Anthropological issues derived from archaeological and early historical investigations. Topic will change each semester. Prerequisites: Anthropology 166 or equivalent. 3 units. *Hammond*

243S. Theory and Method in Archaeology. Techniques of geochronology, environmental reconstruction, sociocultural reconstruction, and statistical analyses applied to problem areas in archaeology. Prerequisite: Anthropology 166 or consent of instructor. 3 units. *Hammond*

244S. Primate Behavior. Social behavior of prosimians, monkeys, and apes and the evolutionary development of primates. 3 units. *Glander*

245. Functional and Evolutionary Morphology of Primates. History and functional significance of locomotor and feeding adaptations, craniofacial morphology, sense organs, and reproductive systems in primates, including *Homo sapiens*. Prerequisite: Anthropology 132 (Anatomy 231), or equivalent, or consent of instructor. Not offered in 1978-1979, or 1979-1980. (Also listed as Anatomy 238.) 3 units. *Cartmill, Hylander, or Simons*

246. The Primate Fossil Record. Evolution of man and other primates as inferred from fossil remains. Prerequisite: a course in human evolution or consent of instructor. 3 units. *Cartmill, Kay, or Simons*

249S. Topics in Economic Anthropology. Current research problems. Topic will change each semester. Prerequisite: Anthropology 94 or consent of instructor. 3 units. *O'Barr, Quinn, or Smith*

251. Ethnography of Humor. Examination of theoretical framework, research methods, and data collection techniques for the analysis of humor with the goal of discerning normative behavioral patterns, expectations regarding social roles, interpersonal relationships and social institutions, and the nature of ideologies and world views, within and across cultures. Prerequisite: Anthropology 94, or consent of instructor. 3 units. *Apte*

258S. Symbols in Society. Symbolic action and expressive culture among tribal, peasant, and industrial societies. Approaches emphasized are functionalism, symbolic interaction, structuralism, and cultural interpretation. 3 units. *Pessar*

264. Anthropological Approaches to Religion. A cross-cultural perspective on the means by which religion orders experience, orients behavior, and promotes and stabilizes conflict and change. Ethnographic cases and theories of symbols, ritual, myth, witchcraft, and millenarianism. 3 units. *Pessar*

267. Cognitive Anthropology. Culturally shared systems for categorizing, decision making, information processing, and performing other cognitive tasks. Prerequisite: Anthropology 165 or consent of instructor. 3 units. *Quinn*

270. Ethnographic Field Methods. Research strategies and field work techniques. 3 units. *Quinn*

271. Methods of Data Analysis. Quantitative analysis of anthropological data. 3 units. *Quinn*

275. Rank, Power, and Authority in Preindustrial Societies. Social, economic, and political stratification in specific societies in Oceania, Africa, and the New World. Prerequisite: major in anthropology or graduate standing. 3 units. *Fox or Smith*

276S. Topics in Kinship. Current research problems. Topic will change each semester. 3 units. *Quinn*

277. Class, Ethnicity, and Public Policy. (Also listed as Public Policy Sciences 275.) 3 units. *Stack*

278S. Topics in Political Anthropology. Current research problems. Topic will change each semester. Prerequisite: Anthropology 134 or consent of instructor. 3 units. *O'Barr, Pessar, or Quinn*

280S, 281S. Seminar in Selected Topics. Special topics in methodology, theory, or area. Prerequisite: consent of instructor. 6 units. *Staff*

282S. Seminar on Canada. See course description for History 282S. (Also listed as Economics 282S, Political Science 282S, and Sociology 282S.) 3 units. *Staff and visitors*

291, 292. Anthropological Theory. Theoretical, methodological, and comparative issues. Prerequisite: consent of instructor. 6 units. *Fox or Quinn*

For Graduates

330, 331. Seminar in Anthropology. A seminar for advanced students who wish to pursue individual studies in social and cultural anthropology. Offered both semesters. 1 to 3 units each semester. *Staff*

334. Topics in Physical Anthropology. 3 units. *Staff*

335, 336. Linguistic Theory and Methods. Basic course for graduate students in the anthropology graduate program. 3 units each semester. *Apte*

393. Individual Research in Anthropology. A course for the student preparing the A.M. thesis or the Ph.D. dissertation. Supervision and guidance of intensive research on a problem approved by the student's departmental advisory committee. 3 units. *Staff*

402. Interdisciplinary Seminar in the History of the Social Sciences. A survey of the theories, methods, and tools applied to problems in the history of the social sciences. 3 units. *Goodwin, Holley, and Spragens*

410. Seminar in the Government, History, and Social Structure of India and Pakistan. 3 units. *Fox and staff*

Art

Professor Spencer, *Director of Graduate Studies*; Professors Markman and Sunderland; Assistant Professors Connolly, Goffen, and Kinkead

Graduate work in the Department of Art is offered leading to the A.M. degree in art history and is designed to provide basic training in the history of art with specialization in a given field selected by the student after consultation with and approval of the Director of Graduate Studies. Prospective students should present a minimum of 24 semester hours of undergraduate work in the history of art. In special cases a student who does not fulfill this prerequisite may be required to attend prescribed undergraduate courses. A reading knowledge of one foreign language (preferably German) is required; candidates who do not meet this requirement upon admission to the program are expected to do so by the end of their first term in residence.

The program for the A.M. degree in art history consists of 30 units as follows: 12 units in art history; 6 units in an approved minor; 6 units in the major or minor, or other approved subject; and 6 units in thesis. A written thesis is required. Candidates must also pass written comprehensive examinations testing their knowledge of art history and pertinent bibliographical resources.

For Seniors and Graduates

233. Early Medieval Architecture. The development of religious architecture from the time of Constantine to the end of the First Romanesque style in the third quarter of the eleventh century. (Also listed under Medieval and Renaissance Studies.) 3 units. *Sunderland*

238S. Studies in Italian Renaissance Art. Specific problems dealing with iconography, style, or an individual master from ca. 1300 to 1600. (Subject varies from year to year.) Prerequisite: consent of instructor. 3 units. *Goffen*

240. Spanish Baroque Painting. Development of seventeenth-century painting in Spain, with emphasis upon the Schools of Seville and Madrid. Prerequisite: consent of instructor. 3 units. *Kinkead*

244. Problems in Nineteenth-Century Art. 3 units. *Connolly*

249. Problems in Pre-Columbian Art and Archaeology. Architecture, sculpture, and other arts of the indigenous civilizations in Mexico, Central America, and the Andean region. Prerequisite: consent of instructor. 3 units. *Markman*

250. Problems in Latin American Art. Architecture, painting, sculpture, and other arts with emphasis on colonial architecture of Central America. Open to seniors who have a reading knowledge of Spanish and/or have had courses in Latin American history, economics, or literature. 3 units. *Markman*

254. Problems in Modern Architecture. A particular movement, master, or idea studied as a problem in criticism and methodology; influence on design and building. Prerequisite: Art 62 or consent of instructor. 3 units. *Staff*

257. Problems in Modern European Art. Selected topics in twentieth-century art, with emphasis on major movements of masters. Prerequisite: consent of instructor. 3 units. *Staff*

291S. Methods in Art History. Various approaches to the study of works of art, including iconology, and stylistic analysis. Open to art majors and others by consent of instructor. 3 units. *Spencer*

293, 294. Special Problems in Art History. Individual study and research. 6 units. *Staff*

Asian Languages

The courses are offered as an enrichment for students interested in the South Asian subcontinent and may be taken as a general elective by advanced undergraduate students. No major work is offered in Hindi-Urdu.

Hindi-Urdu 200-201. Special Studies in South Asian Languages. Intensive concentration in advanced Hindi reading and conversation, or specialized graded work in cognate South Asian languages necessary for the advanced student contemplating field work in South Asia. Prerequisite: consent of instructor. 6 units. *Siddiqi*

Hindi-Urdu 203. Studies in Commonwealth Literature. Readings in English. Study of the literature of the Commonwealth countries of South Asia, Africa, South East Asia, Australia, New Zealand, and the British West Indies. Emphasis on contemporary fiction in particular, and all creative writing in general, to social, political, and economic change in the postcolonial period. 3 units. *Siddiqi*

For courses in Chinese and Japanese, see *Bulletin of Undergraduate Instruction*.

Biochemistry

Professor Hill, *Chairman* (255 Nanaline H. Duke); Professor Guild, *Director of the Genetics Division* (138B Nanaline H. Duke); Associate Professor Richardson, *Director of Graduate Studies* (208 Nanaline H. Duke); Professors Fridovich, Gross, Handler,* Kamin, Kirshner, McCarty, Rajagopalan, Tanford, and Webster; Associate Professors Bell, Greene, Kaufman, Kim, Lynn, Reynolds, Sage, Siegel, and Sullivan; Assistant Professors Greenleaf, Habig, Holmes, Kredich, Lefkowitz, McKee, Modrich, Pizzo, Roses, Steege, and Wheat; Associates Bittikofer and Nozaki; Assistant Medical Research Professors C. Bonaventura and J. Bonaventura

Graduate work in the Department of Biochemistry is offered leading to the Ph.D. degree. Preparation for such graduate study may take diverse forms. Undergraduate majors in chemistry, biology, mathematics, or physics are welcome, but adequate preparation in chemistry is essential. Graduate specialization areas include protein structure and function, crystallography of macromolecules, nucleic acid structure and function, lipid biochemistry, membrane structure and function, molecular genetics, enzyme chemistry, and neurochemistry. The division of genetics of the department, in cooperation with the University Program in Genetics, offers biochemistry students the opportunity to pursue advanced research and study to fulfill the requirements for the Ph.D. degree.

209-210. Independent Study. A tutorial designed for students who are interested in either a laboratory or a library project in biochemistry. Credit to be arranged. *Staff*

216. Molecular Genetics. Genetic mechanisms and their relationship to nucleic acids and their synthesis. Prerequisites: introductory courses in biochemis-

*On leave of absence.

try and genetics, or consent of instructor. (Also listed under the University Program in Genetics.) 4 units. *Guild and others of the University Program in Genetics*

219. Molecular and Cellular Bases of Development. See course description for Anatomy 219. (Also listed as Microbiology 219, Pathology 219, and Physiology 230.) Fall. 3 units. *Padilla and staff*

219L. Optional laboratory offered in conjunction with the lecture. Techniques of organ and cell culture, chromosome morphology, and some electron microscopy as applied to development and differentiation. 2 units. *Bolognesi, Johnson, Kaufman, and McCarty*

219S. Seminar. Optional seminar in conjunction with Biochemistry 219.

220. Adaptations of Organisms to the Marine Environment. Basic concepts of biochemistry and variables in the marine environment which evoke adaptive responses. Adaptations at the molecular level and the general topic of biological fitness are considered. Laboratory experiments utilize basic methods of biochemical analysis. Prerequisites: basic biology and chemistry, and consent of instructor. 1 unit. *C. Bonaventura and J. Bonaventura*

222. Structure of Biological Macromolecules. Introduction to the techniques of structure determination by X-ray crystallography and study of some biological macromolecules whose three-dimensional structures have been determined at high resolution. 2 units. *Kim and Richardson*

224. Biochemistry of Development and Differentiation. The course represents an extension of topics covered in the first semester course 219. Emphasis will be on the control of transcription and translation of messenger RNA in mammalian cells. These studies include gene amplification, postsynthetic modifications of chromosomal proteins, as a result of hormone induction. Specific systems will include the development of the mammary gland, the pancreas, and the chick oviduct. 1 unit. *McCarty*

227. Introductory Biochemistry I: Intermediary Metabolism. Prerequisite: organic chemistry. (Also listed as Botany 227.) 3 units. *Sage and Siegel*

228. Introductory Biochemistry II: Molecular Biology. Prerequisite: Biochemistry 227 or equivalent. (Also listed as Botany 228.) 3 units. *Greenleaf, Webster, and staff*

241. General Biochemistry. An introductory survey of fundamental aspects of biochemistry with emphasis on the structure of macromolecules, mechanism of enzyme action, metabolic pathways, biochemical genetics, and the structure and functions of special tissues. Designed for medical students; graduate students only with consent of instructor. 4 units. *Hill and staff*

265S, 266S. Seminar. Topics and instructors announced each semester. Half course; or variable. *Staff*

276. Comparative and Evolutionary Biochemistry. Lectures and discussion of the origin of life, evolution of genetic code, mutation and protein polymorphism, natural selection and protein structure, and comparison of homologous proteins and nucleic acids. Laboratory work involves the purification and characterization of homologous proteins from fish and invertebrates. Techniques include salt fractionation, electrophoresis, ion-exchange and molecular exclusion chromatography, fingerprinting, molecular weight determination, amino acid composition, and other related approaches. Prerequisite: consent of instructor. (Given at Beaufort.) (Also listed under Marine Sciences.) 6 units. *Sullivan*

282. Experimental Genetics. Laboratory exercises and discussions on the molecular mechanisms of mutation, recombination, replication, transcription, and translation of the genetic material. Prerequisite: consent of instructor. (Also listed under the University Program in Genetics.) 2 units. *Modrich and others in the University Program in Genetics*

284. Current Topics in Genetic Mechanisms. A seminar and lecture course devoted to the analysis of the current literature in molecular genetics. Given in response to adequate demand. Prerequisites: Genetics 280, or equivalent, and consent of instructor. (Also listed under the University Program in Genetics.) 1 unit. *Staff of the University Program in Genetics*

286. Current Topics in Immunochemistry. The structure, function, and specificity of antibodies. Immunogenicity and tolerance with special emphasis on current theories of the diversity and synthesis of antibody molecules. 2 units. *Sage*

288. The Carbohydrates and Lipids of Biological Systems. The subjects will be considered in the following two general categories: (a) the relationship between chemical structure and biological function, and (b) biosynthesis and catabolism. 2 units. *Kaufman*

291. Physical Biochemistry. Principles of thermodynamics, hydrodynamics, spectroscopy, and X-ray diffraction and scattering are applied to biological systems. Biological molecules and macromolecules in both soluble and crystalline states are discussed. Prerequisite: undergraduate physical chemistry, including solution thermodynamics, kinetics, introductory quantum mechanics, and introductory crystallography. 3 units. *Tanford, Reynolds, Richardson, and Kim*

292. Proteins and Enzymes. Topics in protein chemistry including purification techniques, determination of primary structure, group specific modification and structure-function correlations. Mechanisms of action of enzymes, including the chemistry of nonprotein cofactors. Prerequisite: advanced organic chemistry. 4 units. *Fridovich, Rajagopalan, Hill, and Richardson*

296. Biological Oxidations. A lecture, conference, and seminar course on the mechanism of electron transport and energy conservation in purified enzymes and in organized systems such as the mitochondrion, the endoplasmic reticulum, and the chloroplast. 2 units. *Kamin, Fridovich, Rajagopalan, and Siegel*

297. Intermediary Metabolism. The synthesis and degradation of carbohydrates, lipids, proteins, and nucleic acids will be discussed in detail with emphasis on energy transformation and metabolic interrelationships. 3 units. *Bell, Greene, Kirshner, and Siegel*

299. Nutrition. This course examines the experimental basis for the identification and quantification of requirements for calories, macronutrients, and micronutrients—vitamins and minerals; the biochemistry of nutrition with the assessment of nutriture; and the biological effects of deficiency or excess of nutrients. The course seeks to define optimal nutriture and will search for factual bases for common beliefs on nutrition. Informal lectures and, if possible, student seminars. Prerequisite: a basic biochemistry course, or equivalent, or consent of instructor. 2 units. *Kamin*

302. Neurochemistry. Aspects of structure, function, and metabolism unique to the nervous system. Properties and interactions of neuroreceptors and nerve-muscle relationships. 3 units. *Bell, Kaufman, Kirshner, and Vanaman*

305. Nucleic Acids. Current developments in biosynthesis, processing, modification, restriction, and repair of nucleic acids. Sequencing techniques,

secondary and tertiary structures of DNA and RNA. Prerequisite: introductory biochemistry. 2 units. *Kim, Modrich, and Steege*

345, 346. Biochemistry Seminar. Required of all biochemistry students. 1 unit each semester. *Bell*

351, 352. Genetics Seminar. Required of all students specializing in genetics. (Also listed under the University Program in Genetics.) 1 unit each semester. *Modrich and others of the University Program in Genetics*

390. Biochemistry of Membranes. Physical and chemical properties of biological membranes. Properties of constituent lipids and proteins in relation to membrane function. 2 units. *Reynolds, Tanford, and Bell*

Botany

Professor White, *Chairman* (149 Biological Sciences); Professor Strain, *Director of Graduate Studies* (136 Biological Sciences); Professors Anderson, Antonovics, Billings, Boynton, W. Culberson, Hellmers, Johnson, Naylor, Philpott, Stone, and Wilbur; Associate Professors Barber, Knoerr, and Searles; Assistant Professors Christensen, Ramus, and Siedow; Lecturer C. Culberson

Graduate work in the Department of Botany is offered leading to the A.M. (nonthesis), M.S. (thesis), and Ph.D. degrees. Before undertaking graduate study in botany a student should have had in the undergraduate program at least 12 semester hours of botany beyond an elementary course, and related work in biological sciences. Some work in chemistry and physics will be desirable and, for some phases of botanical study, a necessity. The student's graduate program is planned to provide a broad basic training in the various fields of botany, plus intensive specialization in the field of the research problem.

203. Cytogenetics. Organization and variation of chromosomes in relation to genetics and evolution. Meiotic behavior and variations, chromosomal rearrangements, polyploidy, karyotype evolution, and mechanisms of chromosomal changes. Prerequisite: one year of biology. 3 units. *Anderson*

203L. Cytogenetics. See Botany 203. Lectures and laboratories. 4 units. *Anderson*

204L. Marine Microbiology. The major groups of marine micro-organisms, their taxonomy, culture, physiology, and ecology. Prerequisite: a course in introductory biology or botany. (Given at Beaufort.) (Also listed under Marine Sciences.) 6 units. *Cavaliere (visiting summer faculty)*

207L. Microclimatology. (Also listed as Forestry and Environmental Studies 204.) 3 units. *Knoerr*

209L. Lichenology. Morphology, systematics, and biological and ecological implications of the lichens. Collection and identification of specimens and the use of lichen chemistry in taxonomy. 3 units. *W. Culberson and C. Culberson*

210L. Bryology. Morphological, systematic, and ecological characteristics of mosses and liverworts. 4 units. *Anderson*

211L. Marine Phycology. Introduction to marine algae; systematics, morphology, physiology, and ecology. Field trips, laboratory, and lectures. (Given at Beaufort.) (Also listed as Marine Sciences 211.) 6 units. *Searles*

212L. Phycology. Morphological and ecological characteristics of common freshwater and marine algae and principles of their classification. 4 units. *Searles*

214L. Biological Oceanography. (Also listed as Zoology 214L.) (Given at Beaufort.) 6 units. *Barber*

215. Phytoplankton. Identification, taxonomy, morphology, growth, seasonal succession, vertical distribution and migration of marine phytoplankton. Laboratory and field exercises. Prerequisites: introductory biology. (Given at Beaufort.) 4 units. *Ramus*

216. Photosynthetic Physiology of Marine Plants. Variations in photosynthetic mechanisms and their ecological consequences in seaweeds and seagrasses. Topics include light capture, carbon reduction pathways, carbon allocation, dark respiration, photorespiration, growth strategies and competitive interaction. Analytical methodologies used in laboratory and field exercises. Prerequisites: introductory biology, organic chemistry and physics or consent of instructor. (Given at Beaufort.) (Also listed under Marine Sciences.) 6 units. *Ramus*

217L. Environmental Instrumentation. (Also listed as Forestry and Environmental Studies 217.) Prerequisite: consent of instructor. 3 units. *Knoerr*

218. Barrier Island Ecology. Adaptation of plants to barrier island migration and other physical characteristics of the coastal environment. Major emphasis will be placed on management of barrier beaches from Maine to Texas and the impact of human interference with natural processes. Field studies. Prerequisite: course in general ecology. (Given at Beaufort.) (Also listed as Forestry and Environmental Studies 218 and under Marine Sciences.) 6 units. *Godfrey*

221L. Mycology. Field and laboratory study of vegetative and reproductive structures of the fungi and slime molds. Methods of collection, isolation, propagation, and identification of the major orders as represented in local flora. Prerequisite: one year of biological science. 4 units. *Johnson*

225T, 226T. Special Problems. Students with adequate training may do special work in the following fields. Credit to be arranged. 1 to 4 units.

1. Cytology: Bryology. *Anderson*
2. Genetics. *Antonovics*
3. Ecology. *Billings*
4. Phycology. *Ramus*
5. Genetics. *Boynton*
6. Ecology. *Christensen*
7. Lichenology. *Culberson*
8. Physiology. *Hellmers*
9. Bacteriology; Mycology. *Johnson*
10. Physiology. *Naylor*
11. Anatomy and Morphology of Vascular Plants. *Philpott*
12. Phycology. *Searles*
13. Systematics of Flowering Plants. *Stone*
14. Ecology. *Strain*
15. Anatomy and Morphology of Vascular Plants. *White*
16. Systematics and Taxonomy of Vascular Plants. *Wilbur*
17. Physiology. *Siedow*

227. Introductory Biochemistry I: Intermediary Metabolism. Chemistry of the constituents of proteins, lipids, carbohydrates, and nucleic acids and their metabolic interrelationships. Prerequisites: organic chemistry. (Also listed as Biochemistry 227.) 3 units. *Sage and Siegel (biochemistry)*

228. Introductory Biochemistry II: Molecular Biology. Metabolism of DNA and RNA: protein synthesis including regulatory aspects; and special topics in molecular biology. Prerequisite: Botany 227 or equivalent. (Also listed as Biochemistry 228.) 3 units. *Greenleaf, Webster, and staff (biochemistry)*

233L. Microbiology. Introduction to bacteriology, virology, cell biology, and immunology. Structure, metabolism, and growth of bacteria; the properties of bacterial and animal viruses; and basic immunology. (Also listed as Microbiology 233.) 3 units. *Willett (microbiology), Burns (microbiology), Joklik (microbiology), and Amos (microbiology)*

235. Evolutionary Systematics. See Zoology 235. 3 units. *Bailey (zoology), Lundberg (zoology), and Stone*

235L. Evolutionary Systematics. Same course as 235 with laboratory included. 4 units. *Bailey (zoology), Lundberg (zoology), and Stone*

236S. Major Global Ecosystems. Study of a single global ecosystem; e.g., arctic and alpine systems, deserts, tropical rainforests, grasslands, or coniferous forests; including the roles and effects of primitive and modern peoples. Prerequisite: one ecology course. 3 units. *Billings*

242L. Systematics. Principles of vascular plant taxonomy, with practice in identification of the local flora. Lectures, laboratories, and field trips. Prerequisite: one year of biology. 4 units. *Wilbur*

244L. Diversity of Plants. Surveys major groups of living plants with emphasis on algae, bryophytes, and vascular plants. Field observations and collections stress coastal botany and provide a basis for independent projects. Not open to students who have had Botany 145L. Prerequisite: introductory biology. (Also listed under Marine Sciences.) (Given at Beaufort.) 6 units. *White*

245L. Plant Diversity. Major groups of the living plants, their evolutionary origins and phylogenetic relationships. Prerequisite: introductory biology. 4 units. *W. Culberson and White*

246L. Ecology of Plants. Principles of the relationships between plants and their environments. Structures and processes of ecosystems. Laboratory, lectures, and field trips. Prerequisites: introductory biology and one other course in biology. (Also listed as Botany 146L.) 4 units. *Billings, Christensen, or Strain*

247L. Plant Ecology. Principles of the relationships between plants and their environments. Emphasis on structures and processes of coastal plain ecosystems. Not open to students who have had Botany 246L. Prerequisite: introductory biology. (Given at Beaufort.) (Also listed as Botany 147L and under Marine Sciences.) 6 units. *Christensen*

250L, S. Plant Biosystematics. Descriptive and experimental procedures used to assess systematic implications of vascular plant evolution. Laboratory, discussion, and field oriented problems. Prerequisites: basic courses in systematics and genetics. 4 units. *Stone*

251L. Plant Physiology. The principal physiological processes of plants including respiration, photosynthesis, water relations, and factors associated with plant morphogenesis. Prerequisites: introductory college biology and one year of chemistry; organic chemistry is desirable. (Also listed as Botany 151L.) 4 units. *Siedow*

252S. Plant Metabolism. Physiochemical processes and conditions underlying the physiology of plants. Prerequisite: Botany 151 or equivalent; organic chemistry is recommended. 3 units. *Siedow*

253. Advanced Plant Physiology. Physiological consequences of physical principles as related to ion transport, water relations, and the interconversion of energy in plant cells. Prerequisites: Botany 151L; Mathematics 32 or equivalent. 3 units. *Naylor and Siedow*

256. Physiological Role of Minerals and Water. Availability, uptake, transport, and function of minerals and water in plant growth. Prerequisite: Botany 151L or equivalent. 3 units. *Hellmers*

257S. Principles of Plant Distribution. Interpretation of floristic and ecological plant geography. Prerequisites: Botany 146L or equivalent, and a course in plant taxonomy. 3 units. *Billings*

258. Physiology of Growth and Development. Consideration of the internal factors and processes leading to the production of new protoplasm and its differentiation at the cellular, tissue, and organ level in plants. Lectures. Prerequisite: Botany 151L or equivalent; organic chemistry is recommended. 3 units. *Naylor*

260L. Plant Anatomy. A comparative study of basic cell types, tissues, and organs of vascular plants. Correlation of anatomical information with pertinent literature, application of anatomy to problems in systematics and evolution, and the interrelationship between structure and function. Prerequisite: one year of biology or consent of instructor. (Also listed as Botany 160L.) 4 units. *Philpott and White*

261. Photosynthesis. Principles of plant photosynthesis: developmental, mechanistic, regulatory, and ecological aspects of the photosynthetic process. Prerequisite: Botany 151L or 251L. 3 units. *Naylor or Siedow*

265. Physiological Plant Ecology. The physiological approach to interpreting adaptation in plants, with emphasis on terrestrial seed plants. Prerequisites: Botany 146L and 151L, or equivalents. 3 units. *Strain*

265L. Physiological Plant Ecology. See Botany 265. Lectures and laboratories. 3 units. *Strain*

267L. Plant Community Ecology. Concepts and methods of plant synecology. Introduction to the plant communities of North Carolina. Prerequisites: Botany 142L and 146L, or equivalents, and consent of instructor. 3 units. *Christensen*

280. Principles of Genetics. Structure and properties of genes and chromosomes in individual organisms and in populations. Prerequisites: introductory biology, Chemistry 12, and Mathematics 31, or equivalents. (Also listed as Zoology 180, Zoology 280, and under the University Program in Genetics.) 3 units. *Antonovics, Boynton, and Gillham (zoology)*

280L. Principles of Genetics. Same course as 280 with laboratory included. 3 units. *Antonovics, Boynton, and Gillham (zoology)*

283. Extrachromosomal Inheritance. Genetics, biochemistry, and molecular biology of the organelles of eukaryotic cells, bacterial plasmids and episomes, and cellular symbionts. Emphasis on recent literature. Prerequisite: introductory genetics. (Also listed as Zoology 283 and under the University Program in Genetics.) 3 units. *Boynton and Gillham (zoology)*

285S. Ecological Genetics. Interaction of genetics and ecology and its importance in explaining the evolution, diversity, and distribution of plants and animals. Prerequisites: Botany 180 and 286 or their equivalents. 3 units. *Antonovics*

286. Evolutionary Mechanisms. Population ecology and population genetics of plants and animals. Fitness concepts, life history evolution, mating systems, genetic divergence, and causes and maintenance of genetic diversity. Complements Botany 235. Prerequisite: genetics. (Also listed as Zoology 286 and under the University Program in Genetics.) 3 units. *Antonovics and H. Wilbur (zoology)*

287S. Quantitative Genetics. Analysis of genetic variation in continuous traits. Models of continuous variation; genetic, environmental, and interaction components; genetic correlation; heritability estimation; selection response. Prerequisites: Botany 180 or 280, or equivalent, and consent of instructor. (Also listed under the University Program in Genetics.) 3 units. *Antonovics*

295S, 296S. Seminar. Credit to be arranged. *Staff*

300. Tropical Biology: An Ecological Approach. Highly intensive, field-oriented course conducted in Costa Rica under auspices of the Organization for Tropical Studies. For additional information refer to Special and Cooperative Programs in this bulletin. 6 to 8 units. *Staff*

305. Tropical Studies. Highly intensive, field-oriented courses conducted in Latin America under auspices of the Organization for Tropical Studies. For additional information refer to Special and Cooperative Programs in this bulletin. 4 to 8 units. *Staff*

344S. Micrometeorology and Biometeorology Seminar. (Also listed as Forestry and Environmental Studies 344.) 2 units. *Knoerr*

359-360. Research in Botany. Individual investigation in the various fields of botany. Credit to be arranged. *All members of the graduate staff*

The University Program in Genetics. Genetics courses offered by the botany department are an integral part of this interdepartmental program. Refer to the announcement in this bulletin under the University Program in Genetics for descriptions of the following courses: 216, Molecular Genetics; 280, Principles of Genetics; 282, Experimental Genetics; 283, Extrachromosomal Inheritance; 284, Current Topics in Genetic Mechanisms; 285S, Population Genetics; 286, Evolutionary Mechanisms; 287S, Quantitative Genetics; 336, Immunogenetics; 351-352, Genetics Seminar.

Program in Tropical Biology. Fellowships are available for travel and subsistence in field-oriented programs in Central America. Refer to the section, Organization for Tropical Studies, in this bulletin in the chapter on Special and Cooperative Programs.

The University Program in Marine Sciences. Interdisciplinary programs emphasizing marine botany are available. Refer to the section in this bulletin entitled Marine Sciences—The University Program.

Business Administration

Thomas F. Keller, Ph.D., *Dean* (115 Social Science); Professors Baligh, Cohen, Forsyth, Hamner, Laughhunn, Lewin, Morey, and Peterson; Associate Professors Baker Battle, Burton, Dellinger, Dittman, Huber, Hughes, Lewicki, Maier McCann, Owen, Payne, and Vander Weide; Assistant Professors Collier, Eaker, Espejo, Kessler, Magat, Mericle, Monroe, and Taylor

The Graduate School of Business Administration offers work leading to the M.B.A. and Ph.D. The programs of study leading to the first degree are described in the *Bulletin of the Graduate School of Business Administration*. The Ph.D. program is designed for students who desire to enter either the academic profession or advanced and specialized administrative research positions. The program accepts students with bachelor's degree preparation and normally requires three to four years.

One year of study (30 units) beyond completion of the Duke M.B.A. degree or its equivalent is planned for each doctoral candidate. The year of study should

include two courses in advanced economic theory, two courses in mathematics or statistics, and three courses in an elected field of administration. The latter are individually designed and are offered on a tutorial basis to provide extensive reading in the historical and current literature, and a demanding research program.

The requirements of the Graduate School are applicable to students in the Ph.D. program in business administration.

Management science courses open only to students in health administration are listed under the Department of Health Administration.

Refer to the *Bulletin of the Graduate School of Business Administration* for a complete list of courses and course descriptions.

309.1–.9. Research in Managerial Economics. 1–6 units.

319.1–.9. Research in Quantitative Methods. 1–6 units.

329.1–.9. Research in Organization Theory and Management. 1–6 units.

339.1–.9. Research in Information and Accounting Systems. 1–6 units.

349.1–.9. Research in Public Policy and Social Responsibility. 1–6 units.

359.1–.9. Research in Finance. 1–6 units.

369.1–.9. Research in Marketing. 1–6 units.

379.1–.9. Research in Production. 1–6 units.

392–393. Tutorial in Interdisciplinary Areas. 1–6 units.

397. Dissertation Research.

Chemistry

Professor Krigbaum, *Chairman* (101 Gross Chemical Laboratory); Professor Jeffs, *Director of Graduate Studies* (329 Gross Chemical Laboratory); Professors Bradsher, Chesnut, Hobbs, McPhail, Poirier, Quin, Smith, Strobel, Wells, and Wilder; Associate Professors Baldwin, Crumbliss, Henkens, Lochmüller, Palmer and Porter; Assistant Professors Anderson, Luken, and Shaw; Visiting Assistant Professor Leiby; Adjunct Associate Professors Baier, Ghirardelli, Gutnecht, Pitt, and Spielvogel; Adjunct Assistant Professor Switzer

In the Department of Chemistry graduate work is offered leading to the A.M. and Ph.D. degrees. Before undertaking a graduate program in chemistry, a student should have taken an undergraduate major in chemistry, along with related work in mathematics and physics.

Graduate courses in the department are offered in the fields of analytical, inorganic, organic, and physical chemistry. Research programs are active in all these fields.

A booklet providing detailed information on the department is available from the Director of Graduate Studies.

For Seniors and Graduates

201. Molecular Spectroscopy. Selected spectroscopic methods in the study of molecular structure. Symmetry and group theoretical basis for selection rules, theories of magnetic and optical resonance, and interpretation of spectra; examples from both inorganic and organic chemistry. Three lectures. Prerequisite: consent of department. 1 to 3 units. *Staff*

203. Quantum Chemistry. Basic principles of quantum and group theoretical methods. Topics include symmetry, a review of the fundamentals and the mathematical foundations of quantum theory. Emphasis on the application of

molecular orbital theory to organic and inorganic systems. Three lectures. Prerequisite: consent of department. 1 to 3 units. *Staff*

205. Structure and Reaction Dynamics. Structure and mechanisms in organic and inorganic compounds, substitution reactions, linear free energy relations, and molecular rearrangements. Emphasis on the use of kinetic techniques to solve problems in reaction mechanisms. Three lectures. Prerequisite: consent of department. 1 to 3 units. *Staff*

207. Principles of Thermodynamics, Diffraction, and Kinetics. Three lectures. Prerequisite: consent of department. 1 to 3 units. *Staff*

230. Environmental Oceanography. Chemical, biological, and geological aspects of pollution in the marine environment. Anthropogenic effects upon natural marine processes on shore lines and shelves. Application of marine science to utilization of marine resources. Prerequisite: consent of instructor; physical chemistry is recommended. (Given at Beaufort.) (Also listed under Marine Sciences.) 6 units. *Staff*

240. Chemical Oceanography. Distribution, alteration, and transport of chemical species in the marine environment. Field cruises to gather samples for evaluating chemical processes in the ocean. Lectures, laboratory work, and field trips. Prerequisite: consent of instructor; physical chemistry is recommended. (Given at Beaufort.) (Also listed under Marine Sciences.) 6 units. *Staff*

275, 276. Advanced Studies. (1) Analytical chemistry; (2) inorganic chemistry; (3) organic chemistry; and (4) physical chemistry. Open to especially well-prepared undergraduates by consent of department. 6 units. *Staff*

For Graduates

300. Basic Statistical Mechanics. Fundamentals of quantum and classical statistical mechanics using the ensemble approach. Emphasis on systems of weakly interacting particles with internal degrees of freedom. 3 units. *Staff*

302. Basic Quantum Mechanics. The fundamentals of quantum mechanics with special emphasis on chemical applications. Topics included are: linear algebra, the uncertainty relations, angular momentum, perturbation theory and time dependent phenomena, molecules in electromagnetic fields, group methods, and electron correlation. 3 units. *Staff*

303, 304. Special Topics in Physical Chemistry. Presentation of one or more topics of staff interest such as advanced methods in crystallography, light scattering and small angle X-ray diffraction, application of ESR spectroscopy to chemical problems, electronic spectroscopy of proteins, group theory, intermolecular forces, liquid crystals, methods of determining the rates of elementary steps in reaction kinetics, physical chemistry of aerosols, physical-chemical methods of polymer characterization, structure and bonding in metallo-enzymes, statistical mechanics of fluids, topics in structural chemistry, and triplet excitons. 1 to 3 units each semester. *Staff*

310. Theoretical and Structural Inorganic Chemistry. An advanced study of theoretical concepts and structural determination techniques as applied to inorganic systems. Areas included are crystal field and ligand field theories, magnetic susceptibility, and electronic, infrared, and Raman spectroscopy. 3 units. *Crumbliss and Palmer*

312. Inorganic Reactions and Mechanisms. Chemistry of main group and transition elements. Emphasis on current developments in synthetic and

mechanistic studies of inorganic, organometallic, and organometalloid compounds. 3 units. *Crumbliss and Wells*

313, 314. Special Topics in Inorganic Chemistry. Lectures, oral reports, and discussions on advanced topics and recent advances in the field of inorganic chemistry. Examples of topics which may be discussed are bioinorganic chemistry, fluxional molecules, homogeneous catalysis, synthesis and properties of selected groups of compounds, and new physical methods. 1 to 3 units each semester. *Staff*

320. Synthetic Organic Chemistry. A study of the scope and limitations of the more important types of reactions in synthetic organic chemistry. Some discussion of the rapidly developing use of transition metals, complex hydrides, and photochemistry will be included. 3 units. *Baldwin or Bradsher*

322. Organic Reactive Intermediates. A discussion of reactive intermediates in organic chemistry. Topics will include carbanions, carbenes, carbonium ions, free radicals, photochemical excited states, and other reactive species. 3 units. *Porter and Wilder*

323, 324. Special Topics in Organic Chemistry. Advanced topics and recent developments in the field of organic chemistry. Each year heterocyclic chemistry or the chemistry of natural products will be among the topics presented. Lectures, and written and oral reports. 1 to 3 units each semester. *Staff*

330. Chemical Separation Methods and Kinetics in Analytical Chemistry. The principles of rate processes and diffusion; plate-theory, adsorption and chemical selectivity. Thermodynamics of processes leading to differential migration in chromatography. Kinetic methods of analysis with emphasis on the quantitative determination of concentration in biological and nonbiological systems. 3 units. *Staff*

331, 332. Special Topics in Analytical Chemistry. An advanced treatment of important areas in modern analysis. Possible topics include: electrochemistry, small computer applications, magnetic resonance, and problem-solving approaches. 1 to 3 units each semester. *Staff*

334. Chemical Instrumentation and Applied Spectroscopy. Principles of instrumental design. Topics covered include input transducers, dispersive devices, servo systems, operational amplifiers, and digital logic. An introduction to advanced topics in analytical spectroscopy. Fourier transform methods in infrared and n.m.r. spectroscopy, X-ray fluorescence, applications of lasers to high-speed measurements, and fast-scan spectrophotometry. 3 units. *Staff*

373, 374. Seminar. Required of all graduate students in chemistry. One hour a week discussion. 1 unit each semester. *All members of the graduate staff*

375, 376. Research. The aim of this course is to give instruction in methods used in the investigation of original problems. Individual work and conferences. 1 to 6 units. *All members of the graduate staff*

377. Research Orientation Seminar. A survey of departmental research. Required of all entering graduate students in chemistry. Prerequisite: consent of the Director of Graduate Studies. 1 unit. *All members of the graduate staff*

Classical Studies

Professor Oates, *Chairman* (325 Carr); Associate Professor Rigsby, *Director of Graduate Studies* (326 Carr); Professors Richardson and Willis; Associate Professors Burian, Rigsby, and Stanley; Assistant Professor Younger; Visiting Professor Levy

The Department of Classical Studies offers two programs leading to the Ph.D. degree, one with emphasis on literature and philology, the other with emphasis on ancient history and archaeology. For regular admission to the program in literature and philology, a student must offer three years of college study above the elementary level in one of the classical languages and two college years in the other. Students wishing to enter the program in ancient history and archaeology will be required on entrance to demonstrate satisfactory competence in both Greek and Latin for reading in the primary sources; failure to demonstrate such competence will require modification of the student's program to repair the deficiency.

The department's special requirements, in addition to the general requirements of the University for the Ph.D. degree set forth in the section on Program Information of this bulletin, are presented in a sheet that may be obtained from the Director of Graduate Studies. They include special requirements in seminars, course work, and the preliminary examination for the Ph.D. degree.

A reading knowledge of German and French is required of all candidates for the Ph.D. degree. The candidate should meet one of the language requirements by the end of the first term in residence and the other by the end of the third term.

GREEK

For Seniors and Graduates

200. Graduate Reading. Open to qualified undergraduates by consent of the instructor. 3 units. *Staff*

203. Homer. The *Iliad* and *Odyssey*; the problems of language and structure in the epic; present state of Homeric scholarship. 3 units. *Levy or Stanley*

205. Greek Lyric Poets. Fragments of the early lyric poets; selected odes of Pindar and Bacchylides. 3 units. *Stanley or Burian*

206. Aeschylus. The *Oresteia*, with study of the form of *Agamemnon* and its place in the design of the trilogy. 3 units. *Willis*

208. Sophocles. The Theban plays; the structure and style of Sophoclean tragedy. 3 units. *Stanley or Burian*

209. Euripides. Representative tragedies in their political and philosophical context; analysis of dramatic form and texture. 3 units. *Stanley or Burian*

210. Aristophanes. Origin and development of Greek comedy; representative plays of Aristophanes. 3 units. *Burian*

221. Early Greek Prose. Greek prose in the fifth century from the Ionian scientists and logographers to Herodotus, Gorgias, Antiphon, and the Old Oligarch. 3 units. *Willis*

222. Thucydides. The *History*; Thucydides' historical method and style. 3 units. *Willis*

223. Greek Orators I. Early fourth-century rhetoric, including Andocides, Lysias, and Isocrates. 3 units. *Burian*

224. Greek Orators II. Aeschines' *Against Ctesiphon* and Demosthenes' *On the Crown* in the light of fourth-century political history and rhetorical development. 3 units. *Willis*

225. Plato. Selected dialogues and related passages illustrating the development of philosophical topics and stylistic motifs. 3 units. *Burian or Stanley*

231. Hellenistic Poetry. The principal lyric, elegiac, pastoral, and didactic poets of Alexandria; emphasis on Callimachus and Theocritus. 3 units. *Stanley*

241. Advanced Prose Composition. Xenophon, Lysias, and other prose authors as models of style and practice in the writing of Attic prose. 1 unit. *Willis*

For Graduates

(At least two of these are offered each year.)

301. Greek Seminar I. 3 units.

302. Greek Seminar II. 3 units.

303. Greek Seminar III. 3 units.

304. Greek Seminar IV. 3 units.

305. Greek Seminar V. 3 units. *Stanley*

306. Greek Seminar VI. 3 units. *Oates*

311. Proseminar in Papyrology. 3 units. *Willis*

313. Proseminar in Greek Epigraphy. 3 units. *Rigsby*

321. Seminar in Literary Papyri. 3 units. *Willis*

323. Seminar in Documentary Papyri. 3 units. *Oates*

399. Directed Reading and Research. Credit to be arranged. *Stanley*

LATIN

For Seniors and Graduates

200. Graduate Reading. Open to qualified undergraduates by consent of the instructor. 3 units. *Stanley or Younger*

201. The Verse Treatise. The genre of didactic poetry; emphasis on Lucretius' *De Rerum Natura*, Vergil's *Georgics*, and Ovid's *Ars Amatoria*; attention to Cicero's *Aratea*, the *Astronomica* of Manilius, Horace's *Ars Poetica*, and Ovid's *Fasti*. 3 units. *Newton or Richardson*

202. Roman Satire. A survey of the genre with concentration on Horace, Juvenal, and Persius. 3 units. *Richardson*

203. Epic: Vergil. The *Aeneid*. 3 units. *Newton*

204. Epic: Lucan and Statius. The development of the Roman epic in the Silver Age. 3 units. *Richardson*

207. The Prose Epistle. The letter as a vehicle of communication and as a literary form. 3 units. *Richardson*

208. The Epistle in Verse. The letter as a literary form; reading in the *Epistles* of Horace, the *Heroides* of Ovid, and Statius. 3 units. *Staff*

209. Fragments of Early Latin. The remains of Latin poetry of the third and second centuries B.C., from Livius Andronicus to Lucilius, with emphasis on the epic and drama of Ennius. 3 units. *Stanley*

210. Lyric and Occasional Poetry. Shorter verse forms: epigram, pastoral, song, and panegyric. 3 units. *Richardson or Burian*

211. Roman Oratory I. The literary history and criticism of Roman oratory. 3 units. *Richardson*

212. Roman Oratory II. A continuation of Latin 211. 3 units. *Staff*

221. Medieval Latin I. Latin literature of late antiquity, from Prudentius to the Carolingian Revival. (Also listed under Medieval and Renaissance Studies.) 3 units. *Newton*

222. Medieval Latin II. Literature in Latin from Charlemagne to the Renaissance. (Also listed under Medieval and Renaissance Studies.) 3 units. *Newton*

225. Latin Paleography. Latin book hands from the Roman Empire to the Italian Renaissance. (Also listed under Medieval and Renaissance Studies.) 3 units. *Newton*

241. Advanced Latin Composition. Experiments in imitation of the great Latin prose styles and introduction to the composition of verse. 1 unit. *Richardson*

250. Teaching Latin. Objectives, methods, and problems; the study of textbooks, programs, and related materials. 3 units. *Staff*

For Graduates

(At least two of these are offered each year.)

301. Latin Seminar I. 3 units.

302. Latin Seminar II. 3 units.

303. Latin Seminar III. 3 units.

304. Latin Seminar IV. 3 units.

305. Latin Seminar V. (Also listed under Medieval and Renaissance Studies.) 3 units. *Richardson*

306. Latin Seminar VI. (Also listed under Medieval and Renaissance Studies.) 3 units. *Newton*

312. Proseminar in Latin Paleography. (Also listed under Medieval and Renaissance Studies.) 3 units. *Newton*

314. Proseminar in Latin Epigraphy. 3 units.

315. Proseminar in Roman Law. 3 units.

399. Directed Reading and Research. Credit to be arranged. *Newton*

CLASSICAL STUDIES

For Graduates

301. Introduction to Classical Philology I. Introduction to the bibliography and principal disciplines of the field. 3 units. *Staff*

302. Introduction to Classical Philology II. A continuation of Classical Studies 301. 3 units. *Staff*

351. The Teaching of Classics. The student is introduced to the problems involved in teaching the classics. Regular classroom observation and some teaching experience. No credit. *Staff*

CLASSICAL STUDIES (ANCIENT HISTORY)

253. Greece to the Orientalizing Period. 3 units. *Rigsby*

254. The Age of the Tyrants and the Persian Wars. 3 units. *Oates*

255. The Age of Pericles. 3 units. *Oates*

256. The Fourth Century through Alexander. 3 units. *Oates*

257. Social and Cultural History of the Hellenistic World from Alexander to Augustus. 3 units. *Rigsby*

258. Social and Cultural History of the Graeco-Roman World. 3 units. *Staff*

260. The History of Rome to 146 B.C. 3 units. *Staff*

261. The Roman Revolution, 146-30 B.C. 3 units. *Oates*

262. Rome under the Julio-Claudians. 3 units. *Staff*

263. From the Flavian Dynasty to the Severan. 3 units. *Staff*

264. From Septimius Severus to Constantine. 3 units. *Staff*

270. The Rise of the Hellenistic Kingdoms. 3 units. *Oates*

271. The Hellenistic World, 250-31 B.C. 3 units. *Oates*

For Graduates

(At least two of these are offered each year.)

321. Seminar in Ancient History I. 3 units.

322. Seminar in Ancient History II. 3 units.

323. Seminar in Ancient History III. 3 units.

324. Seminar in Ancient History IV. 3 units.

325. Seminar in Ancient History V. 3 units. *Oates*

326. Seminar in Ancient History VI. 3 units. *Oates*

327. Seminar in Byzantine History. (Also listed under Medieval and Renaissance Studies.) 3 units. *Rigsby*

399. Directed Reading and Research. Credit to be arranged. *Staff*

CLASSICAL STUDIES (ARCHAEOLOGY)

For Seniors and Graduates

231S. Greek Sculpture. Techniques and styles of the major schools and personalities in archaic, classical, and Hellenistic free-standing and architectural sculpture. 3 units. *Stanley*

232S. Greek Painting. Techniques and style in the various media; emphasis on the problems of chronology, attribution, and iconography of Attic pottery. 3 units. *Stanley*

235S. Roman Architecture. Significant monuments chosen to exemplify the Roman genius in building in the late Republic and early Empire. 3 units. *Richardson*

236S. Roman Painting. Roman pictorial art with concentration on the wall paintings from Campania. Investigation of techniques, iconography, and the use of pictures in decoration. 3 units. *Richardson*

For Graduates

(One course is offered each year.)

311. Archaeology Seminar I. 3 units. *Richardson or Stanley*

312. Archaeology Seminar II. 3 units. *Younger*

Under the terms of a cooperative agreement, graduate students of Duke University may, with the approval of the Chairman of their major department and upon payment of a nominal fee, take any graduate course offered by the Department of Classics of the University of North Carolina. A list of these courses will be sent upon request.

Comparative Literature

No graduate degree is offered in comparative literature. The following courses may serve, however, in the minor programs of students in other departments. Consult Professor Rolleston in the Department of Germanic Languages.

220S. Comparative Literature Seminar. Topics vary. 3 units. *Jantz*

280. Literary Criticism. Emphasis on structuralist and poststructuralist theories and their antecedents. Lectures and discussion by an interdepartmental team. 3 units. *Stewart*

399. Special Readings. 3 units. *Staff*

Computer Science

Professor Patrick, *Chairman* (203 North); Associate Professor Biermann, *Director of Graduate Studies* (204 North); Professors Gallie, Loveland, Marinos, Naylor, Starmer, and Woodbury; Associate Professors Brandwajn, Ramm and Wagner; Assistant Professor Trivedi; Adjunct Professor Williams

The Department of Computer Science offers programs leading to the A.M. and Ph.D. degrees.

A student entering graduate work in computer science should have a knowledge of mathematics through advanced calculus, of data structures, and of assembler as well as higher level computer programming languages. Research interests of present faculty include mathematical foundations of computer science, artificial intelligence, program verification, programming languages, real-time computing, operating systems, information storage and retrieval, computer design, simulation of systems of interest to social scientists, and numerical analysis.

For Seniors and Graduates

200. Programming Methodology I. Practical and theoretical topics including structured programming, specification and documentation of programs, debugging and testing strategies, choice and effective use of programming languages and systems, psychology of computer programming, proof of correctness of programs, analysis of algorithms, and properties of program schemata. Prerequisite: Computer Science 152. 3 units. *Wagner*

201. Programming Languages. Information binding, data structures and storage, control structures, recursion, execution environments, input/output;

syntax and semantics of languages; study of PL/I, Fortran, Algol, APL, LISP, SNOBOL, and SIMULA; exercises in programming. Prerequisite: Computer Science 200. 3 units. *Wagner*

207. Fault-Tolerant Computer Systems. (Also listed as Electrical Engineering 207.) 3 units. *Marinos*

208. Digital Computer Design. (Also listed as Electrical Engineering 208.) 3 units. *Marinos or Owen*

215. Artificial Intelligence. Heuristic versus algorithmic methods; programming of games such as chess; theorem proving and its relation to correctness of programs; readings in simulation of cognitive processes, problem-solving, semantic memory, analogy, adaptive learning. Prerequisite: Computer Science 152 or consent of instructor. 3 units. *Biermann*

221. Numerical Analysis I. Error analysis and interval arithmetic, interpolation and polynomial approximation methods, numerical differentiation and integration, solution of simultaneous linear equations and matrix inversion, real and complex roots of nonlinear equations. Prerequisites: knowledge of an algorithmic programming language and intermediate calculus. (Also listed as Mathematics 221.) 3 units. *Gallie or Patrick*

222. Numerical Analysis II. Calculation of eigenvalues and eigenvectors, numerical methods for solving ordinary differential equations, partial differential equations, and integral equations. Prerequisite: Computer Science 221 or equivalent. (Also listed as Mathematics 222.) 3 units. *Patrick or Utku*

224. Logic and Algorithms. Programming languages as formal languages. Elements of propositional and predicate logic. Algorithm design and analysis. Nondeterministic algorithms. Prerequisite: Computer Science 152 and four semesters of college mathematics. 3 units. *Staff*

225. Formal Languages and Theory of Computation. An introduction to the study of abstract machines and the languages they define, their capabilities and limitations. Finite-state automata; regular languages; pushdown automata; context-free languages; Turing machines; recursive functions and recursively enumerable sets; noncomputable sets; measures of complexity for algorithms. Prerequisite: four semesters of undergraduate mathematics. 3 units. *Loveland*

226. Mathematical Methods for Systems Analysis I. Basic concepts and techniques used in the stochastic modeling of systems. Elements of probability, statistics, queuing theory and simulation. Prerequisite: four semesters of college mathematics. 3 units. *Trivedi*

227. Mathematical Methods for Systems Analysis II. Basic concepts and techniques used in the deterministic modeling of systems. Elements of linear algebra; linear, integer, dynamic and geometric programming; and unconstrained and constrained optimization. Prerequisite: four semesters of college mathematics. 3 units. *Staff*

231. Introduction to Operating Systems. Basic concepts and principles of multiprogrammed operating systems. Memory, CPU, I/O device management and scheduling. Buffering techniques. Performance evaluation. Case studies of existing systems. Prerequisite: Computer Science 154. 3 units. *Brandwajn and Trivedi*

232. Compiler Construction. Models and techniques used in the design and implementation of assemblers, interpreters, and compilers. Lexical analysis, compilation of arithmetic expressions and simple statements, specifications of syntax,

algorithms for syntactic analysis, code generation and optimization techniques. 3 units. *Wagner*

241. Data Base Management Systems. Basic concepts and principles. Relational, hierarchical, and network approaches to data organization; systems and language support for data base systems; theories of data organization; security and privacy issues. Prerequisites: Computer Science 152 and 154. 3 units. *Starmer*

244. Decision Models of the Firm. (Also listed as Economics 244.) Fall. 3 units. *Naylor*

250. Clustering and Classification. Algorithms and operating characteristics of clustering and classification methods. Data models for sequential data acquisition, clustering in terms of nearest neighbor, and/or mixtures of distributions-missing information principle. Characterization of patient groups versus normal groups and selection of measures to characterize diseases as superclusters. Application of Bayes' procedures to classification into clusters and superclusters. Prerequisite: consent of instructor. 3 units. *Woodbury*

252. Computer Systems Organization. Hardware and software aspects. Processor, memory, device, and communication subsystems; case studies of hardware system organization, e.g., parallel, associative, fault-tolerant; organization of software systems to exploit hardware systems organization; economic and reliability aspects of various hardware organizations. Prerequisites: Computer Science 154 and 157. (Also listed as Electrical Engineering 252.) 3 units. *Trivedi*

265. Advanced Topics in Computer Science. 3 units. *Staff*

For Graduates

301. Topics in Programming Theory. Advanced topics in theory of programming will be selected from areas of current research. Prerequisite: Computer Science 201 or consent of instructor. 3 units. *Wagner*

308. Advanced Topics in Digital Systems. (Also listed as Electrical Engineering 308.) 3 units. *Marinos*

315. Advanced Artificial Intelligence. Course content will vary from year to year and will include a detailed study of one or more of the following: mechanical theorem proving, natural language processing, automatic program synthesis, machine learning and inference, representations of knowledge, languages for artificial intelligence research, artificial sensorimotor systems, and others. Prerequisite: Computer Science 215. 3 units. *Biermann*

321. Topics in Numerical Mathematics. Advanced topics in numerical mathematics to be selected from areas of current research. Prerequisites: Computer Science 221 and 222. 3 units. *Gallie or Patrick*

325. Theory of Computation. Elements of recursive function theory: s-m-n theorem, recursion theorem. Abstract computational complexity: essentially complex functions, Blum speed-up theorem. Concrete complexity and analysis of algorithms, e.g., matrix multiplication. Subrecursive hierarchies: the deterministic and nondeterministic polynomial bound hierarchies. Program schemata. Techniques for proving properties of programs. Emphasis among above topics will vary from year to year. Prerequisite: Computer Science 225 or equivalent. 3 units. *Loveland*

326. Systems Modeling. Advanced study of analytical models of systems; queuing model and its parameterization and validation. Methods for computer

solutions of some models. Prerequisites: Computer Science 226 and 231. 3 units. *Brandwajn and Trivedi*

331. Operating Systems Theory. Advanced study of theoretical aspects of operating systems emphasizing models and control of concurrent processes, processor scheduling, and memory management. Prerequisites: Computer Science 226 and 231. 3 units. *Brandwajn and Trivedi*

332. Topics in Operating Systems. Advanced topics in operating systems to be selected from areas of current research. Prerequisite: Computer Science 331. 3 units. *Brandwajn and Trivedi*

344. Workshop on Computer Models of Social Systems. See course description for Economics 344. (Also listed as Economics 344, Political Science 344, and Sociology 344.) 3 units. *Naylor 3 units. Newton*

Economics

Professor Kelley, *Chairman* (215A Social Science); Professor Weintraub, *Director of Graduate Studies* (315 Social Science); Professors Blackburn, Bronfenbrenner, Davies, Goodwin, Grabowski, Graham, Kreps, Lewis, Naylor, Saville, Tower, Trembl, Vernon, Wallace, and Yohe; Associate Professors de Marchi, Fenoaltea, Havrilesky, and McElroy; Assistant Professors Bolnick, Conrad, Dutton, Lipscomb, Tauchen, and Weymark

The Department of Economics offers graduate work leading to the A.M. and Ph.D. degrees. Among the undergraduate courses of distinct advantage to the graduate student in economics are statistics, economic theory, and basic courses in philosophy, mathematics, and social sciences other than economics. Advanced work in mathematics or statistics is also useful.

Requirements for the Ph.D. degree in economics include courses in economic theory in the first year, and at the end of the second year, an examination in economic analysis. In addition a student must obtain certification in three fields, one of which may be in an outside minor. The student may select from advanced economic theory, history of political economy, economic development, economic history, international economics, money and banking, labor economics, public finance, industrial organization, econometrics, statistics, Soviet economics, and certain fields outside the economics department (e.g., demography). Course work for the Ph.D. degree should be completed in five semesters of residence.

For Seniors and Graduates

200. Capitalism and Socialism. Selected ideological classics of new and old, right and left economics including both "counsels for perfection" (Utopias) and "precepts for action" in political economy. Prerequisite: Economics 149 or 154, or consent of instructor. 3 units. *Bronfenbrenner*

204S. Advanced Money and Banking. Monetary theory and its statistical and institutional implementation. Particular attention is given to the development of aggregative theories of prices, interest rates, and production; the functioning of monetary policy within various theoretical frameworks; and appraisal of the recent use and the limitations of Federal Reserve policy. 3 units. *Havrilesky or Yohe*

231S. Analytical Economic History. An introduction to the methods of the new economic history; problems of measurement, comparative and counterfactual analysis, partial and general equilibrium models, rational market behavior, and institutional choice. Prerequisites: Economics 138, 149, and 154. 3 units. *Fenoaltea*

232. Economic History of Japan. Japanese economic development, stressing the period since the end of isolation. Prerequisite: one semester of economic analysis or of Far Eastern history. (Also listed as History 260.) 3 units. *Bronfenbrenner*

233. State and Urban Finance.* Expenditures, taxation, and financial administration in state and local governments, with emphasis on current problems. Special attention will be given to research methods and materials, and to the financial relations between state and local governments. 3 units. *Davies*

237, 238. Statistical Methods. A study of statistical methods appropriate for dealing with problems in business and social science. In addition to developing more thoroughly the subject considered in business statistics, the following methods will be considered: simple, multiple, partial, and curvilinear correlation; curve fitting; probability; sampling distributions; and statistical inference. Prerequisite: Economics 138 or consent of the instructor. 6 units. *Staff*

243. Econometrics I. Economic theory, mathematics, statistical inference, and electronic computers applied to analysis of economic phenomena. Objective is to give empirical content to economic theory. Matrix algebra used to develop topics in inference, linear regression, and systems of simultaneous equations. Use is made of the electronic computer. 3 units. *Wallace*

244. Decision Models of the Firm. Various approaches to modelling firm behavior, including marginal analysis, mathematical programming, dynamics, risk, simulation, investment, game theory, and behavioral analysis. (Also listed as Computer Science 244.) Fall. 3 units. *Naylor*

245. Econometrics II. Advanced theory and applications: includes specification error, generalized least squares, lag structures, Bayesian decision-making, simultaneous equation methods, and forecasting. Emphasis on current applied literature. A Track 1, third-level course. Prerequisite: Economics 243. 3 units. *McElroy or Wallace*

246. Selected Topics in Econometric Theory. Topics include analysis of panel data, combining data from different sources, random coefficients models, Box-Jenkins methods and problems of causation in time series data, limited dependent variables and sample selection bias, and other topics to be chosen subject to the interests of the class. 3 units. *Wallace*

257. Manpower and Human Resources. Allocation of human resources; returns to investments in education and training; qualitative composition of the labor force. *Kreps*

262. Trade Unionism and Collective Bargaining. An intensive survey of the trade union as an economic institution is followed by a study of the principles and problems of union-management relationship as found in collective bargaining. 3 units. *Staff*

265S. International Trade and Finance. A study of fundamental principles of international economic relations. Subjects covered include the economic basis for international specialization and trade, and the economic gains from trade, the balance of international payments, problems of international finance, investments, and monetary problems. Prerequisite: Economics 149. 3 units. *Bronfenbrenner or Tower*

282S. Seminar on Canada. See course description for History 282S. (Also listed as Anthropology 282S, Political Science 282S, and Sociology 282S.) 3 units. *Staff and visitors*

*Offered on demand.

287. Public Finance. Economic aspects of such problems as the growth of government, the proper role of the state, the centralization and decentralization of government, government bureaucracy, the impact of taxes and spending on the wealthy and the poor as well as other public policies and questions. 3 units. *Davies*

293. Soviet Economic History. Establishment of foundations of a socialist economy: collectivization, industrialization, and search for economic efficiency. 3 units. *Trembl*

294S. Soviet Economic System. Economic planning and administration in the Soviet Union and other socialist countries. International comparisons. Theoretical and applied problems of resource allocation, economic development, and optimal micro decision-making in a nonmarket economy. 3 units. *Trembl*

For Graduates

301. Microeconomic Analysis I. Review of contemporary theory relating to production, the firm, and income distribution in competitive and imperfectly competitive markets. 3 units. *Graham*

302. Microeconomic Analysis II. A continuation of Economics 301 with emphasis on analyses of consumer behavior, general equilibrium, welfare economics, and capital theory. Prerequisite: Economics 301. 3 units. *Weintraub or Weymark*

303. Theory of Economic Decision-making. The extension of economic theory to the allocation of resources within firms and governmental units. Prerequisite: Economics 301 or equivalent. 3 units. *Graham or Weymark*

304, 305. Monetary Theory and Policy. In the first semester: theories of the supply of and demand for money (neoclassical and Keynesian macroeconomic), general equilibrium theories, and theories of the term structure of interest rates. In the second semester: the theory and practice of the monetary policy with emphasis on recent issues, the monetarist-fiscalist controversy, the monetary policy transmission mechanism, and policy simulations with econometric models. 3 units each semester. *Havrilesky or Yohe*

307. Quantitative Analysis I. A systematic analysis of the principal quantitative methods used in microeconomic theory. Neoclassical theories of production and distribution are used as vehicles for presenting the material. Considerable emphasis is placed on the application of mathematical analysis to economic models. 3 units. *Staff*

308. Quantitative Analysis II. Linear economic models, particularly Leontief models, are used in the exposition. Primary emphasis is placed on the application of mathematics to economic theory. Prerequisite: Economics 307 or consent of instructor. 3 units. *Graham*

311, 312. History of Political Economy. A detailed review of the development of economic theory, the tools of economic analysis, and economics as a science, together with an analysis of the circumstances affecting this development. Period covered: pre-Christian times through 1936. 3 units each semester. *Goodwin*

313, 314. Seminar in Economic Theory. Prerequisite: Economics 301 or equivalent. 3 units each semester. *Weintraub*

316. Seminar in Economics of Soviet-Type Socialism. Selected topics in analysis of theoretical and institutional framework of Soviet economic system, such as markets versus plan, optimizing techniques in planning, price determina-

tion, balanced economic development, and ideology and economic policy. 3 units. *Trembl*

317. Seminar in Demographic, Population, and Resource Problems. 3 units. *Kelley*

318. Dissertation Seminar. 3 units. *Staff*

319. Seminar in the Theory and the Problems of Economic Growth and Change. 3 units. *Staff*

320. Macroeconomic Analysis I. Measurement of national income and other important aggregates; classical macroeconomics; Keynesian and more recent views of the determinants of income, employment, and price levels; empirical studies of consumption, investment, and monetary variables. 3 units. *Bronfenbrenner*

321. Theory of Quantitative Economic Policy. The use of mathematical models in analyzing the connections between means and ends of economic policy; topics covered include principles and design, centralization and decentralization, stabilization and growth policies, welfare optimization, imperfect models, and the use of control system analysis. Prerequisite: Economics 320. 3 units. *Staff*

322. Macroeconomic Analysis II. Further analysis of topics treated in Economics 320. Optimal economic growth; business cycles. Issues in economic policy. Prerequisite: Economics 320. 3 units. *Graham or Weintraub*

323. Income Distribution Theory. Income distributions—functional and personal. Concepts and measures of poverty and inequality. Maldistribution issues—ethical and economic. Pricing of productive services, primary attention on wages and employment. Rival aggregative (macrodistribution) theories. Prerequisites: intermediate micro and macroeconomics and some knowledge of calculus and statistics. 3 units. *Bronfenbrenner*

329. Federal Finance. An analysis of the trends and hypotheses concerning the growth in governmental activity, the optimum level and composition of governmental spending, and the microeconomic and macroeconomic effects of governmental spending and tax policies. 3 units. *Davies*

330. Seminar in Public Finance. 3 units. *Staff*

331. Seminar in Economic History. 3 units. *Staff*

344. Applied Econometric Modelling. Techniques and analysis of industrial, regional, and national modelling. 3 units. *Naylor*

345, 346. Demographic Techniques I and II. (Also listed as Sociology 345, 346.) 3 units each semester. *Myers*

350. Seminar in Applied Economics. A course that will use the principles of microeconomics in the analysis of problems and policies. The particular contextual materials that will be subjected to analysis will vary from time to time. Materials will be treated in the tradition of positive economics. 3 units. *Staff*

355. Seminar in Labor Economics. 3 units. *Lewis*

358. Seminar in Labor Market and Related Analysis. 3 units. *Lewis*

365. Seminar in International Trade Theory. 3 units. *Tower*

366. Seminar in International Monetary Theory. The monetary, as opposed to the pure, side of international economics. Among the topics considered are the balance of payments, the foreign-exchange market, capital movements, payments

equilibrium, the demand for reserves, and international monetary reform. 3 units.
Tower

388. Industrial Organization.* The theory, measurement, and history of the firm-structure of industry. Emphasis upon the structure of American industry and upon actual production and pricing practices. Criteria for evaluating industrial performance. 3 units. *Vernon or Grabowski*

389. Seminar in Industrial and Governmental Problems.* 3 units. *Vernon*

397, 398. Directed Research.

401. Seminar on the British Commonwealth. 3 units. *Preston and others of the Committee on Commonwealth Studies*

402. Interdisciplinary Seminar in the History of the Social Sciences. 3 units. *Goodwin, Holley, and Spragens*

Related Courses in Other Departments

Courses in related fields may be selected from anthropology, computer science, forestry, history, mathematics, philosophy, political science, public policy sciences, and sociology, or from an area that complements the candidate's area of research interests in economics.

See Program in Comparative Studies on Southern Asia and the Center for Demographic Studies in the chapter on Special and Cooperative Programs for further information.

Education

Professor Flowers, *Chairman* (211 West Duke); Professor Pittillo, *Associate Chairman* (213 West Duke); Professor Carbone, *Director of Graduate Studies* (213 West Duke); Professors Adams, Cartwright, S. Gehman, and Hopkins; Associate Professors Ballantyne, Colver, Davis, Di Bona, Johnson, Kuhn, Martin, and Sawyer; Assistant Professor Michlin; Lecturers Fowler and Anderson

Graduate work in education is offered leading to the A.M., the M.Ed., the M.A.T., the Ed.D., and the Ph.D. degrees. For each of these degrees there are specific requirements and prerequisites, all of which may be found stated in detail in this bulletin. Departmental requirements and prerequisites for all of these degrees, and for the sixth-year Program for Elementary and Secondary Teachers, may be obtained from the Director of Graduate Studies.

From the courses listed below, plus several in related disciplines, a selection may be made which will meet North Carolina requirements for the Advanced Principal's Certificate, the Superintendent's Certificate, and the Supervisor's Certificate.

(Some courses below are offered only in the summer session; see the *Bulletin of Summer Educational Programs*.)

These programs are accredited by the National Council for Accreditation of Teacher Education for the preparation of elementary and secondary school teachers and school service personnel with the doctor's degree as the highest degree approved.

For Seniors and Graduates

201. Mathematics Program in the Elementary School. Objectives, curriculum, and instructional strategies. 3 units. *Kuhn*

*Offered on demand.

- 202. Comparative and International Education: Industrialized Nations.** Structure and functioning of educational institutions in selected developed societies. Relevant social science theory and methods. 3 units. *Di Bona*
- 203. Seminar in Philosophical Analysis of Educational Concepts.** Selected writings of contemporary philosophers; emphasis on such educational concepts as teaching, learning, knowing, understanding, indoctrination, explanation, and education. 3 units. *Carbone*
- 204. Educational Organization.** Theory and research on the processes of exchange between educational organizations and their external environments; influence on organizational structure, goals, and practices. Examining schools, colleges, and universities through a comparative approach with other forms of social organizations: hospitals, businesses, and prisons. 3 units. *Martin*
- 205. Selected Topics.** 3 units. *Staff*
- 206. Studies in the History of Educational Philosophy.** The educational views of leading thinkers in the history of Western philosophy, including Plato, Augustine, Locke, Rousseau, Kant, Whitehead, and Dewey. 3 units. *Carbone*
- 207. Social History of Twentieth-Century American Education.** Twentieth-century American education in the context of social and intellectual history. 3 units. *Johnson*
- 209S. John Dewey.** Dewey's major writings with emphasis on his philosophy of education. 3 units. *Carbone*
- 210. The Politics of Education.** (Also listed as Political Science 210.) 3 units. *Staff*
- 213. Elementary School Organization and Administration.** Nursery school, kindergarten, and the elementary school. Problems of internal organization and management of elementary school and its integration with secondary school. 3 units. *Flowers, or Pittillo*
- 215S. Secondary Education: Principles.** Principles, curriculum, and methods in secondary education. Prerequisite: C average overall and in teaching field or fields. Must be accompanied by Education 216. 3 units. *Cartwright, Kuhn, or Michlin*
- 216. Secondary Education: Internship.** Supervised internship in junior and senior high schools. Full time for half a semester. 6 units. *Cartwright, Kuhn, or Michlin*
- 217. The Psychological Principles of Education.** Advanced study of teaching, learning, and the learner. 3 units. *Sawyer*
- 218S. Comparative and International Education: Developing Societies.** 3 units. *Di Bona*
- 219. Comparative and International Education: South Asia.** Traditional and modern educational developments in India and Pakistan. 3 units. *Di Bona*
- 221. Programs in Early Childhood Education.** Objectives and philosophy underlying programs in early childhood education. 3 units. *Lehane*
- 222. New Developments in Elementary School Curriculum.** 3 units. *Lehane*
- 223. Teaching the Language Arts.** Comparison of current methods and materials in the teaching of handwriting, spelling, and oral and written composition. Analysis and correction of basic difficulties. 3 units. *Adams*

- 224. Teaching the Social Studies in Elementary Schools.** 3 units. *Cartwright*
- 225. The Teaching of History and the Social Studies.** Evaluation of the objectives, content, materials, and methods in the teaching of history and the social studies. 3 units. *Cartwright*
- 226. Teaching Developmental and Remedial Reading in the Elementary School.** Principles, methods, and materials for the development of effective reading attitudes and skills in developmental and remedial programs. 3 units. *Adams*
- 229. Assessments of Reading Disability Cases.** Standardized tests, other methods, and informal procedures used in diagnosing reading problems of elementary and secondary pupils. 3 units. *Adams*
- 230. Research Methodology in Education.** 3 units. *Sawyer*
- 232. Psycho-Educational Counseling with Families.** Individual and group counseling concerning psycho-educational problems of families. Prerequisite: consent of instructor. 3 units. *Ballantyne, Davis, or S. Gehman*
- 233. Improvement of Instruction in English.** Recent developments and research techniques in the teaching of English through individual projects. Prerequisite: consent of instructor. 3 units. *Michlin*
- 234. Secondary School Organization and Administration.** Objectives and philosophy underlying the organization and administration of the secondary school. 3 units. *Flowers*
- 236. Teaching Developmental and Remedial Reading in the Secondary School.** Principles, methods, and materials for the development of effective reading attitudes and skills in developmental and remedial programs. 3 units. *Adams*
- 237. Teaching of Literature in Secondary Schools.** Conventional, adult, and transitional literature are considered. 3 units. *Michlin*
- 238. Content, Supervision, and Administration of Reading Programs.** Objectives, organization, attributes, and evaluation of reading programs. 3 units. *Adams*
- 239. Teaching of Grammar, Composition, Mechanics, and Usage in Secondary School.** Recent developments. 3 units. *Michlin*
- 240. Career Development.** Analysis of the world of work; sociopersonal factors affecting occupational choice; theories of career development; use of occupational and educational resources. 3 units. *Ballantyne*
- 241. Foundations of Counseling and Personnel Services.** Scope, principles, historical background, services, trends, and issues of counseling, and pupil personnel services. 3 units. *Ballantyne*
- 243. Personality Dynamics.** Personality structure and dynamics emphasizing implications for counseling and instruction. Prerequisite: six hours of psychology or educational psychology. 3 units. *S. Gehman*
- 244. Counseling Techniques.** Individual counseling techniques; diagnosis, interviewing, program planning, and counseling evaluation. Prerequisites: Education 243 and 258, or equivalent, which may be taken concurrently. 3 units. *S. Gehman*
- 245. Theories of Counseling.** 3 units. *S. Gehman*

246. Teaching of Mathematics. Aims, curriculum, and classroom procedure for teaching secondary school mathematics. 3 units. *Kuhn*

247. Practicum in Guidance and Counseling. Local field experience in counseling and guidance program. Minimum of 150 hours of case work and supervision. Prerequisites: Education 244 and consent of instructor. 3 units each semester. (May be repeated.) *Ballantyne, Colver, Gehman, or Sawyer*

248. Practicum in Counseling. Individual counseling; test administration, intake interviewing, diagnosis, program planning, and report preparation and evaluation. Minimum of 150 hours of case work and conferences with the supervisor. Prerequisite: consent of instructor. 3 units each semester. (May be repeated.) *Ballantyne, Gehman, or Sawyer*

249. Exceptional Children. Survey of major categories of exceptional children: mentally retarded, emotionally disturbed, brain-injured, learning-disabled, physically handicapped, visually and auditorily deficient, culturally deprived, and gifted. Etiology (biological and environmental factors), diagnosis, and treatment. 3 units. *Davis*

250, 251. Teaching Emotionally Disturbed Children: Internship. Basic principles and practices in teaching and organization of instructional materials. Work with children under supervision of a certified teacher of emotionally disturbed children. Experience in general classroom, small group, and individualized instruction. Participation in staff conferences with psychiatrists, psychologists, social case workers, and professional educators. 3 units each semester. *S. Gehman*

253. Introduction to Law and Education. Basic elements of legal research, with primary emphasis on concepts and procedures relevant to educational problems. Analysis of selected cases. 3 units. *Martin*

254. Law and Higher Education. Concepts and procedures relating to higher education. Emphasis upon court decisions. Prerequisite: Education 253 or consent of instructor. 3 units. *Flowers*

255. Assessment of Abilities. The selection, use, and interpretation of various instruments for predicting and evaluating the outcome of educational experiences including surveys of standardized tests of aptitude and achievement. 3 units. *Colver*

256. Classroom Assessment of Student Achievement. The techniques used by classroom teachers to evaluate student progress. Special emphasis will be directed to tests written by teachers. 3 units. *Colver*

258. Assessment of Personality, Interests, and Attitudes. Rationale, construction, use, and interpretation of standardized instruments designed for the assessment of students' interests, attitudes, and personalities. Emphasis on counseling applications. Prerequisites: Education 243 and 255, or consent of instructor. 3 units. *Colver*

259. Problems in Law and Education. Current issues; researching of cases, constitutional decisions, and statutes. Prerequisite: Education 253 or consent of instructor. 3 units. *Martin, Pittillo, or Flowers*

260. Educational Research I. Research design, univariate quantitative methods, and applications of the computer to research problems. 3 units. *Staff*

261. Educational Research II. Analysis of covariance and multiple regression, discriminant function analysis, computer applications in research. Prerequisite: Education 260 or equivalent. 3 units. *Staff*

262. Educational Research III. Multivariate analysis of variance, factor analysis, cluster analysis, and path analysis. Education 262 is offered only in a block with Education 261. 3 units. *Staff*

266. Basic Science for Teachers. Natural and physical science through selected readings, the use of experiments and demonstrations, construction and use of equipment, and field studies. 3 units. *Staff*

268. Seminar in Contemporary Educational Criticism. 3 units. *Carbone, Di Bona, Johnson, or Martin*

270. Junior and Community College. History, philosophy, and roles. Introductory course for future teachers, counselors, or administrators in a two-year college. 3 units. *Hopkins*

271. Instructional Systems for College and University Teaching. Special attention to alternative systems, and the individualization of instruction for a heterogeneous student population. 3 units. *Hopkins*

272. Teaching Communication Skills in Early Childhood Education. From birth to age eight with emphasis on reading readiness and language growth. 3 units. *Adams*

273, 274. Clinical Reading Practicum. Experiences in the diagnosis and correction of reading disabilities in elementary and secondary students. Prerequisite: consent of instructor. 6 units. *Adams*

276. The Teaching of High School Science. Discussion, lectures, and collateral reading related to such topics as aims, tests, curriculum, classroom and laboratory procedure, field trips, and course and lesson planning for secondary school science. 3 units. *Kuhn*

285. Audiovisual Aids in Education. Aims and psychological bases of audiovisual materials in the classroom. Offered in summer only. 3 units. *Staff*

291. Public and Community Relations of Schools. 3 units. *Staff*

For Graduates

300. Individual Assessment of Intelligence. Individual intelligence as measured by standardized individual instruments, chiefly the Wechsler Intelligence Test for Children and the Stanford-Binet L-M. Theory, administration, scoring, analysis, interpretation, and reporting. Work with children in supervised school settings. Prerequisite: consent of instructor. 3 units. *Davis*

301. Advanced Individual Assessment of Cognitive Abilities. Development of advanced understanding and skills in the use of clinical instruments for assessment of cognitive abilities. Analysis, interpretation, and consultation about individual assessment. Supervised experience involving collaboration with children, school personnel, parents, and clinic and community representatives. Prerequisites: Education 300, or equivalent, and consent of instructor. 3 units. *Davis or S. Gehman*

302. Seminar in Educational Research. The seminar is primarily for students working on dissertations and theses. Special topics are considered as appropriate to the research designs developed. Prerequisite: Education 260 or 261. 3 units. *Staff*

303. Diagnostic and Educational Programs in Learning Disabilities. Diagnostic, intervention, and remediation strategies and program development for the

child with learning disabilities; review of major works in this field. Prerequisite: consent of instructor. 3 units. *Davis or S. Gehman*

304. Internship in School Psychology. Supervised internship in school psychology, utilizing principles and practices in an approved internship site. (May be repeated.) Prerequisite: consent of instructor. 3 units. *Davis*

305. Personality Assessment: Projective Techniques. Theory and practice in the administration, scoring, and interpretation of one or more projective techniques for school age children. Prerequisite: consent of instructor. 3 units. *Staff*

309. Seminar on Higher Education in the United States. Major trends, issues, problems, new developments, and future prospects for higher educational institutions (excluding the junior/community college) in the United States. 3 units. *Flowers*

310. Seminar in Higher Educational Administration. New developments in the organization and administration of higher educational institutions, with special attention to administrative and organizational systems, management information systems, managerial accountability, and strategies for continuous planning and institutional renewal. 3 units. *Hopkins*

311. Group Counseling. Theories and techniques of counseling for small groups of children, adolescents, teachers, parents, and other adults. Prerequisite: consent of instructor. 3 units. *Ballantyne or S. Gehman*

313. Seminar in Education and Public Policy. The relationship of educational administration to the public policy process. (Also listed as Political Science 313.) 3 units. *Leach and Pittillo*

314. Seminar in Guidance and Counseling. Research, writing, and reporting on selected problems in the field of guidance and counseling. 3 units. *Staff*

315. Seminar in Secondary School Teaching. Advanced-level consideration of principles, practices, and problems in secondary school instruction. Designed particularly to accompany an internship. For students without previous internship credit, this course must be accompanied by Education 216. 3 units. *Carbone*

316, 317. Practicum in Higher Educational Research and Development. Review of the purposes and essential stages of research and development in higher education, followed by individual projects covering problem-identification, literature searches related to the problem, development of product specifications and design, and pilot testing of prototype product. 3 units each semester. *Hopkins*

321. Educational Management. Theory and practice of management as applied to education. For anyone who has, or is preparing to have, major management responsibilities in the field of education. 3 units. *Pittillo*

322. Planning and Management of Educational Facilities. For teachers, administrators, and supervisors. 3 units. *Pittillo*

323. Public School Finance. Educational costs, sources of revenue for the support of public education, collection of revenue, basis of distribution, and accounting for funds spent. 3 units. *Pittillo*

326. Educational Psychology: The Problem Child. Problem behavior and adjustment in children with emphasis on the causes and treatment of conduct and neurotic disorders of the maladjusted child. Particular attention will be paid to mental hygiene principles in the handling of problem children in school and at home. 3 units. *Anderson*

- 332. Supervision of Instruction.** The nature of supervision, underlying principles, and techniques of working with individual teachers and with groups. 3 units. *Staff*
- 335, 336. Seminar in School Administration.** Organization and control over public education. First semester: attention to governance of education as exercised by the different branches and levels of government. Second semester: administrative organization. 3 units each semester. *Flowers or Pittillo*
- 337. Seminar in Community College Organization.** The nature, function, and organization of community colleges. Research, writing, and reporting on selected problems. 3 units. *Staff*
- 338. Seminar in Educational Supervision.** Prerequisite: Education 332 or equivalent. 3 units. *Staff*
- 339. Seminar in Curriculum.** Research, writing, and reporting on selected problems. 3 units. *Cartwright*
- 340. Seminar in Social Studies Curriculum.** Research, writing, and reporting on selected problems. 3 units. *Cartwright*
- 341. Seminar in Elementary School Curriculum.** Research, writing, and reporting on selected problems. 3 units. *Staff*
- 342. Seminar in Secondary School Curriculum.** Research, writing, and reporting on selected problems. 3 units. *Cartwright*
- 343. History of Higher Education in America.** The growth and development of higher education in the United States from 1636 to the present. Twentieth-century developments are stressed. 3 units. *Hopkins*
- 344. Research in Higher Education.** Review of theory, practice, and contribution of research as an aid in understanding the functioning of institutions of higher education. 3 units. *Hopkins*
- 345. Seminar in Reading Instruction and Research.** Major problem areas in contemporary reading instruction, with emphasis on theoretical, historical, and philosophical contributions to the formulation of objectives and methodologies in modern reading instruction. 3 units. *Adams*
- 346. Seminar in Organization of Preservice and Inservice Reading Programs.** Theories, content, and instructional strategies for teaching reading and other language arts courses in university and inservice courses. 3 units. *Adams*
- 347. Student Personnel Services in Higher Education.** Basic objectives of student personnel services in postsecondary education and the administrative procedures developed to achieve these objectives. 3 units. *Colver*
- 348, 349. Seminar in Child Psychopathology.** Under the direction of a child psychiatrist, the student will select one elementary school aged child for a psychoanalytic study of neurotic conflicts, unconscious motivations, dream work, defense mechanisms, and transference phenomena. Prerequisite: consent of instructor. 3 units. *Fowler*
- 350, 351. Directed Activities in Education.** Internship experiences at an advanced level under supervision of appropriate staff. Consent of instructor. 3 units each semester. *Staff*
- 357. Directed Research.** For students who have passed the preliminary examination. 1 to 6 units. *Staff*

360. Seminar on Instructional Strategies. Relationships among the broad purposes of education, the process and product objectives, and strategies employed to achieve those purposes and objectives. A synthesis among the purposes, objectives, and strategies is sought. 3 units. *Staff*

Engineering

Aleksandar Sedmak Vesić, D.Sc., Dean (136 Engineering)

The School of Engineering offers programs of study and research leading to the degrees of Master of Science and Doctor of Philosophy with a major in biomedical, civil, or electrical engineering, or in mechanical engineering and materials science. These programs are designed to provide a fundamental understanding of the engineering sciences, which are based on mathematics and the physical sciences, and to develop experience in the art of engineering, which includes strong elements of intuition, imagination, and judgment. Engineering graduate students may participate in seminars appropriate to their fields of study.

A *minimum* of 30 units of earned graduate credit beyond the bachelor's degree is required for the M.S. degree: 12 in the major, 6 in related minor work (usually mathematics or natural science), 6 in either the major or minor subject or in other areas approved by the major department, and 6 for a research-based thesis. A nonthesis option requiring 30 units of course credit is available. Each of the departments imposes additional requirements in the exercise of this option. There is no language requirement for this degree.

A *minimum* of 60 units of earned graduate credit beyond the bachelor's degree is required for the Ph.D. degree. In civil and electrical engineering, 24 units are required in the major field and 12 units in a related minor field (often mathematics or natural science), 12 in either the major or minor subject or other areas approved by the major department and 12 for a research-based dissertation. In biomedical and mechanical engineering there are no specific course requirements; each program is planned to meet individual needs. Doctoral students are required to pass qualifying and preliminary examinations which may be either written, oral, or a combination of written and oral components, at the discretion of the committee and the department.

BIOMEDICAL ENGINEERING

Professor Pilkington, *Chairman* (261 Engineering Annex); Professor Thurstone, *Director of Graduate Studies* (266 New Engineering); Professors Clark, Dvorak, McElhaney, Nolte, and Wolbarsht; Associate Professors Barr, Burdick, Evans, Hammond, and Wachtel; Assistant Professor von Ramm

Biomedical engineering is often defined as the application of the concepts and methods of the physical, mathematical, and engineering sciences to biology and medicine. The definition covers a broad spectrum ranging from formalized mathematical theory through experimental science to practical clinical applications. The purpose of the graduate program in biomedical engineering is to encourage the optimum combining of engineering and biomedical course work with an interdisciplinary research topic so that the graduates of this program can contribute at the most advanced professional level to the interdisciplinary field of biomedical engineering. The major research areas available include: biomechanics, biomedical materials; biomedical modeling; data acquisition and processing; and electrophysiology.

201. Analysis of Bioelectric Phenomena. Fundamentals of bioelectric modeling with particular emphasis on neural and cardiovascular systems exhibiting phenomena varying from cellular to the whole organism level. 4 units. *Wachtel*

202. Energy and Rate in Biological Processes. An introduction to biomedical thermodynamics and transfer processes with particular emphasis on environmental studies, hyperbaric exposure, and the functions of natural and artificial organs. Not open to students who have had Biomedical Engineering 172. 3 units. *Clark*

204. Real Time Measurement and Control of Heart Events. Specification of procedures and devices from biological considerations, and their design and construction. Consideration of amplifiers, analog-digital conversion, computer interfaces, and associated programming. Evaluation of selected examples for accuracy, complexity, and cost. 3 units. *Barr*

207. Experimental Mechanics. Experimental studies and techniques basic to mechanics, stress-strain measurements and transducers, dynamic force, acceleration and flow measurements and analysis, viscoelastic behavior and modeling, high speed photographic methods, general applications to biomechanics including gait and analysis, head injury, automotive safety criteria, and blood flow. 3 units. *McElhaney*

221. Electrophysiological Techniques. Instruction in and practice with contemporary methods in electrophysiology with emphasis on intracellular recording and stimulating techniques. Topics include fabrication and use of microelectrodes, electronic instrumentation, voltage clamping, microiontophoretic techniques, as well as bioelectric data processing and modeling. Format will include lectures and demonstrations, but the main effort will be devoted to practicum work in the laboratory. Offered during summer term I. Prerequisites: Biomedical Engineering 101 or Physiology 225, or permission of instructor. (Also listed as Physiology 221.) 4 units. *Wachtel*

223. Biomedical Materials and Artificial Organs. The use of artificial organs to replace or augment natural function in pumping and oxygenation of blood, removal of nitrogenous wastes and other toxins, and prostheses which have mechanical, chemical, or cosmetic function. Emphasis is placed on molecular architecture of materials for use in biological environment and optimization of parameters of materials which determine their utility in varying applications. 3 units. *Clark*

225. Mechanics of Cellular Components. Concepts of solid, semisolid, and liquid mechanics applied to the study of cell components, e.g., membranes, cytoplasm, organelles, nuclei, etc. Transition from molecular structure to continuum properties will be emphasized. Prerequisite: consent of instructor. 3 units. *Evans*

230. Biomechanics. Kinematic models of human motions, mechanical properties of bone and soft tissues, hydrodynamics of micturition, load directed growth mechanisms, human tolerance to impact and vibration, head injury criteria applied to helmet design. Prerequisite: consent of instructor. 3 units. *McElhaney*

233. Discrete Systems and Models of Computation. Difference equations, numerical approximation, and digital filters with particular emphasis on developing constrained models that are both physically reasonable and amenable to computation. 3 units. *Pilkington*

241, 242. Information Organization and Retrieval. 3 units each semester. *Hammond*

243. Computers in Biomedical Engineering. An in-depth study of the use of computers in biomedical applications. Hardware, software, and applications programming will be considered. Data collection, analysis, and presentation will be

studied within application areas such as monitoring, medical records, computer-aided diagnoses, computer-aided instruction, M.D.-assistance programs, laboratory processing, wave form analysis, hospital information systems, and medical information systems. 3 units. *Hammond*

252. Marine Electrobiolgy. The physiology and behavioral consequences of bioelectric activity, ranging from the cell membrane to the interanimal communication level. Laboratory work deals with bioelectric recording and stimulation techniques with particular emphasis placed on electrophysiological studies of marine organisms wherein cellular correlates of animal behavior are clearly seen. Ionic basis of bioelectric signals, transmission of signals within and between cells, relation of bioelectric signals to particular behavioral patterns, effects of externally applied electric fields, bioelectric communication and navigation systems. Prerequisite: consent of instructor. Summer at Beaufort. (Also listed as Physiology 222.) 6 units. *Wachtel and Wolbarsht*

265. Advanced Topics in Biomedical Engineering. Advanced subjects related to programs within biomedical engineering tailored to fit the requirements of a small group. Prerequisites: consent of Chairman and instructor under whom the work will be done. 1 to 4 units. *Staff*

For Graduates

311. Inverse Models. Analytical and computational methods for determining the internal state of a biological system from a set of external measurements and *a priori* characterization of the system. Particular emphasis is placed on the inherent limitations and difficulties encountered in obtaining numerical solutions from inverse formulations and the value of constraints in reducing these difficulties. 3 units. *Pilkington*

333. Biomedical Imaging. A study of the fundamentals of information detection, processing, and presentation associated with imaging in biology and medicine. Analysis of coherent and incoherent radiation and various image generation techniques. Also covered will be the psychometrics of image evaluation dealing with subjective and objective parameters. Emphasis will be placed upon sonography, thermography, X-ray, various forms of nuclear radiography, microscopy, and holography. 3 units. *Thurstone*

399. Special Readings in Biomedical Engineering. Individual readings in advanced study and research areas of biomedical engineering. Prerequisite: approval of the Director of Graduate Studies. 1 to 3 units each semester. *Graduate staff*

CIVIL ENGINEERING

Professor Melosh, *Chairman* (121 Engineering); Professor Dvorak, *Director of Graduate Studies* (126 Engineering); Professors Brown, Muga, Utku, J.F. Wilson, and Vesić; Associate Professors Palmer, and Vesilind; Assistant Professors Medina and Tsui; Adjunct Professor Saibel; Lecturers Francisco, Hauser, Lathrop, and Rimer

A student may specialize in one of the following fields of study for either the M.S. or the Ph.D. degree: environmental engineering; geotechnical engineering and soil mechanics; mechanics of solids; materials engineering; fluid mechanics, water resources, and ocean engineering; structural engineering; and urban systems and transportation. Interdisciplinary programs combining study in some of the major areas with biological sciences, business administration, materials science, social sciences, political science, and other areas of engineering are also available. In addition, there is a special program leading to the M.S. degree in civil engineering and the A.M. degree in public policy sciences.

With the approval of the department, a master's degree candidate in civil engineering may choose, in lieu of submitting a thesis, to complete an additional 6 units of course work plus a special project. If this alternative is elected, candidates are expected to take comprehensive examinations over their graduate course work, and also to defend orally their special projects.

Under the Reciprocal Agreement with Neighboring Universities, a student may include as a portion of the minimum requirements work offered by the Department of Environmental Sciences and Engineering of the University of North Carolina. Although related work normally is taken in the natural sciences or mathematics, a student whose major interest relates to the social or managerial sciences may take relevant work in these areas.

A minimum prerequisite to the graduate program in civil engineering is a basic knowledge of mathematics through linear differential equations, materials science, solid mechanics, and fluid mechanics.

201. Advanced Mechanics of Solids. Cartesian tensors, dyadics, and matrices. Analysis of states of stress and strain. Conservation laws and field equations. Constitutive equations for elastic, viscoelastic, and elastic-plastic solids. Formulation and solution of simple problems in elasticity, viscoelasticity, and plasticity. 3 units. *Doorak*

204. Plates and Shells. Differential equation and extremum formulations of linear equilibrium problems of Kirchhoffian and non-Kirchhoffian plates of isotropic and orthotropic material. Solution methods. Differential equation formulation of thin shell problems in curvilinear coordinates; membrane and bending theories; specialization for shallow shells, shells of revolution, and plates. Extremum formulation of shell problems. Solution methods. Prerequisites: Mathematics 104, and Engineering 75 or Engineering 135, or consent of instructor. 3 units. *Utku*

205. Elasticity. Introduction to linear theory of elasticity. Constitutive equations for anisotropic and isotropic elastic solids. Formulation and solution of torsion, bending, and plane problems by semi-inverse, complex potential, and variational methods. Three-dimensional problems. Prerequisite: Civil Engineering 201 or equivalent. 3 units. *Doorak*

206. Advanced Mechanics of Solids II. Continuum theories for time-independent and time-dependent materials. Formulation and solution of boundary value problems; analytical and numerical techniques, applications. Prerequisite: Engineering 135 or Civil Engineering 201. 3 units. *Doorak*

209. Structural Dynamics. Vibration and stability (small and global) of discrete and continuous linear systems; introduction to nonlinear theory, parametric and random excitation. Applications include response studies of machines, ships, pipelines, bridges, and buildings to man-made and nature-induced loadings. (Also listed as Mechanical Engineering 209.) 3 units. *J. F. Wilson*

210. Intermediate Dynamics. (Also listed as Mechanical Engineering 210.) 3 units. *Macduff or J. F. Wilson*

212. Mechanical Behavior of Materials. Mechanical behavior and its relationship to microstructural deformation and fracture processes in polycrystalline, polymeric, and composite materials. Influence of temperature, strain rate, and environmental conditions on material behavior. Fracture mechanics and its application to brittle and ductile fracture, and fatigue in structural metals, polymers, composites, and concrete. Prerequisite: Civil Engineering 201. 3 units. *Doorak*

215. Urban and Regional Geography. Human settlements and locational patterns. Location theory and land-use systems. Normative and descriptive

location decisions. Location and impact of constructed facilities. Spatial interaction and network structure. Geography of transportation and environmental quality. 3 units. *Staff*

216. Transportation Planning and Policy Analysis. Issues in policy planning and decision-making in urban and intercity transportation systems. Transportation legislation. Emphasis on analysis and understanding of government transportation programs and policy. Prerequisite or corequisite: Civil Engineering 116 or consent of instructor. (Also listed as Public Policy Sciences 254.) 3 units. *Lathrop*

217. Transportation Systems Analysis. The transportation systems planning process. Quantitative analysis, mathematical modeling and computer simulation techniques for short- and long-range planning and evaluation of transportation systems. Prerequisite or corequisite: Civil Engineering 116 or consent of instructor. 3 units. *Staff*

218. Engineering-Economic Analysis. Methods of analysis applicable to the economic evaluation of both preconstruction project plans and postconstruction project outcomes. Principles of engineering economics with regard to time dependent costs and benefits. Techniques of economic evaluation and comparisons of multiple alternatives. Concepts of welfare economics with regard to public works development. Identification and measurements of both monetary and nonmonetary consequences of public works. Student projects involving the analysis and evaluation of public investments. 3 units. *Staff*

221. Incompressible Fluid Flow. Steady and unsteady pipe flow; theories of turbulent flow; water hammer theory and control; surge tanks; air chambers; the analysis and control of fluid systems; effect of resistance; tapered conductors. 3 units. *Muga*

222. Open Channel Flow. Basic principles. Selected flow problems and practical solutions; gutter and inlet flows, flow over spillways, flow into estuaries and bays. Design of open channel structures, river hydraulics. Design of flood control and navigation structures; culverts, bridge openings, and energy dissipators. 3 units. *Muga*

223. Flow Through Porous Media. Theory of miscible and immiscible fluid displacement processes. Derivation and solution methods. Selected problems in stability, fingering, and capillarity. Applications; saline water intrusion, secondary recovery processes, seepage through earthen dams, dewatering of construction sites, and well point operation. 3 units. *Muga*

224. Coastal and Offshore Engineering. Basic analytical concepts; wave phenomena, theory of surface water wave motion, wave modification, and wave spectra. Effects of waves on structures emphasizing design of marine facilities and other selected problems. 3 units. *Muga*

225. Engineering Hydrology. Dynamics of the occurrence, circulation and distribution of water; hydrometeorology, geophysical fluid motions. Precipitation, surface runoff and stream-flow, infiltration, water losses. Hydrograph analysis, catchment characteristics, hydrologic instrumentation, and computer simulation models. Prerequisite: Engineering 145, or consent of instructor. 3 units. *Medina or Muga*

231. Structural Engineering Analysis. The analysis of fundamental structural forms including arches, suspension cables, and members of variable inertia. Influence lines for indeterminate structures. Introduction to matrix analysis.

Prerequisites: Civil Engineering 131 and Mathematics 104, or consent of instructor. 3 units. *Brown*

232. Reinforced Concrete Design. A critical review of research related to the development of existing codes. Special attention is given to the consideration of temperature change effects, shrinkage, plastic flow, bond, and shear and diagonal tension. Two-way slab and flat plate design. Prerequisite: Civil Engineering 133. 3 units. *Brown*

233. Prestressed Concrete Design. A critical review of research and recent developments in prestressed concrete design. Prestressed tanks, beams, and columns; partial prestressing and composite design. Prerequisite: Civil Engineering 133. 3 units. *Brown*

234. Structural Design in Metals. Design of metal structures using both elastic and plastic theories. Application to plate girders, bridge trusses, and building frames. Interpretation and justification of building codes and specifications. Planning, preliminary design, and organization of design procedures. Prerequisite: Civil Engineering 134. 3 units. *Palmer*

235. Foundation Engineering. An introduction to methods of analysis, design, and construction of foundations. Bearing capacity and settlement of shallow and deep foundations. Soil exploration; excavation and bracing; drainage and stabilization; and underpinning. Foundation vibrations. 3 units. *Vesic*

236. Earth Structures. An introduction to methods of analysis, design, and construction of earth structures such as dams, embankments, cuts, canals, and airfield and highway pavements. Selection of materials, soil compaction, and stabilization. Theory of seepage, design of wells and drainage collectors. Slope stability and related problems. Theory of layered systems and pavement design procedures. 3 units. *Tsui*

238. Rock Mechanics. Behavior and properties of rock as an engineering material; failure of rock. Design and construction of underground structures and slopes in rock; design of rock abutments for dams. Laboratory and field rock testing techniques. Prerequisite: Civil Engineering 139 or consent of instructor. 3 units. *Tsui*

241. Environmental Engineering Chemistry and Biology. Inorganic and organic chemistry as applied to water and wastewater treatment. Chemical equilibria and kinetics. Population dynamics and energy transfer in metabolic systems. Instrumental analysis, including spectrophotometry, chromatography, and atomic adsorption. Atmospheric chemistry and analytical methods. Prerequisite: Civil Engineering 124. 3 units. *Francisco*

243. Sanitary Engineering Unit Operations and Process Design. Fundamental bases for design of water and waste treatment systems, including transport, mixing, sedimentation and filtration, gas transfer, coagulation, and biotreatment processes. Prerequisite: Civil Engineering 124 or consent of instructor. 4 units. *Vesilind*

245. Pollutant Transport Systems. Distribution of pollutants in natural waters and the atmosphere, diffusive and advective transport phenomena within the natural environment and through man-made artificial conduits and storage/treatment systems. Analytical and numerical prediction methods. Prerequisites: Engineering 145 and Mathematics 111 or equivalent. 3 units. *Medina*

246. Sanitary Engineering Design. The study of water resources and municipal water requirements including reservoirs, transmission, treatment and distribu-

tion systems; methods of collection, treatment and disposal of municipal and industrial wastewaters. The course includes the preparation of a comprehensive engineering report encompassing all aspects of municipal water and wastewater systems. Field trips to be arranged. Prerequisite: Civil Engineering 124 or consent of instructor. 3 units. *Rimer and Vesilind*

247. Air Pollution Control. The problem of air pollution, with reference to chemical and biological effects. Measurement and meteorology of air pollution. Air pollution control methods. Noise pollution, odor, and air pollution law. 3 units. *Vesilind*

248. Solid Waste and Resource Recovery Engineering. Engineering design of resource recovery systems including traditional and advanced technologies. Sanitary landfills and incineration of solid wastes. Energy recovery and recycling municipal refuse. Collection, treatment, and disposal of solid wastes from wastewater treatment. Prerequisite: Civil Engineering 124 or consent of instructor. 3 units. *Rimer and Vesilind*

249. Resource Recovery Systems Management. The social, economic, legal, political, and administrative aspects of resource recovery from municipal solid wastes. Economic applications and systems management. Assessment methodologies. Federal and state legislation. Public versus private sector interests. Policy issues. Case studies. Prerequisite: consent of instructor. 3 units. *Warner*

250. Engineering Analysis. Formulation of mathematical models selected from a wide variety of engineering disciplines; optimization; use of infinite series, finite difference calculus, energy methods, and digital computers as problem-solving techniques. 3 units. *J. F. Wilson*

251. Systematic Structural Analysis I. Computer analysis techniques for the equilibrium problems of solids and structures. Describing the problems to a digital computer. Transformation matrices. Recapitulation of energy theorems. Stiffness and flexibility relations of structural elements in discrete space and continuum. Systematic analysis of equilibrium problems by displacement and force methods. Errors. Prerequisites: Mathematics 104, and Civil Engineering 131 or Engineering 135, or consent of instructor. 3 units. *Utku*

252. Systematic Structural Analysis II. Computer analysis techniques for the equilibrium, eigenvalue, and propagation problems of solids and structures. Representation of initial stresses. Handling of geometrical nonlinearities in equilibrium problems. Buckling. Handling of material nonlinearities. Incremental load techniques. Time dependent materials. Representation of inertial and damping forces. Stationary and transient vibrations. Random vibrations. Prerequisite: Civil Engineering 251 or consent of instructor. 3 units. *Utku*

265. Advanced Topics in Civil Engineering. Opportunity for study of advanced subjects relating to programs within the civil engineering department tailored to fit the requirements of a small group. 1 to 3 units. *Graduate staff*

306. Plasticity. Mathematical theories of time-independent inelastic material behavior and their experimental foundations. Yield conditions, flow and hardening rules, unloading, shakedown. Theories of limit analysis. Slipline fields. Numerical methods. Applications to problems in the design of structures, metal forming, stress analysis in metals and composites, and in fracture mechanics. Prerequisite: Civil Engineering 205. 3 units. *Dvorak*

331. Special Problems of Systematic Analysis. Roundoff and truncation errors. Bounds for approximate solutions. Higher order representations and their advantages and disadvantages. Connectivity matrices and systematic substructur-

ing. Improved algorithms for linear equation solution and eigenvalue extraction. Prerequisite: Civil Engineering 252 or consent of instructor. 3 units. *Utku*

335. Mechanical Behavior of Soils. Origin of soils, soil minerals, and processes of soil formation; physical chemistry of multiphase systems and soil structure. Permeability and flow of water through soils: capillary and osmotic phenomena; response of soil to load, strength and deformation testing, constitutive relationships, modern theories of soil behavior. Advanced laboratory soil testing techniques. 4 units. *Vesic*

336. Advanced Soil Mechanics. Theories of plastic and elastic equilibrium of soil masses and their application to analysis of problems such as pressure on retaining walls, anchored bulkheads, cofferdams, silos, shafts, and tunnels; stability of slopes; general analysis of stresses and displacements in soil masses. Prerequisite: Civil Engineering 335. 4 units. *Vesic*

337. Elements of Soil Dynamics. Behavior of soils and foundations under transient and impact loads. Mechanics of pile driving. Foundation vibrations. Effects of explosions on soils: wave propagation, cratering. Earthquake effects on foundations, earth dams, and slopes. Compaction of loose soils by explosives or by vibration. Behavior of layered systems under dynamic loads. Prerequisite: Civil Engineering 335 or consent of instructor. 3 units. *Vesic and Tsui*

350. Advanced Engineering Analysis. Review of general mathematical properties of boundary value, eigenvalue, and initial value problems in continuum. Alternate equivalent formulations. Comparative survey of approximate methods for reducing continuum problems into equivalent discrete problems for numerical solutions. Prerequisites: Computer Science 221 and 222, or consent of instructor. 3 units. *Utku*

399. Special Readings in Civil Engineering. Special individual readings in a specific area of study in civil engineering. Prerequisite: approval of the director of graduate studies. 1 to 3 units. *Graduate staff*

ELECTRICAL ENGINEERING

Associate Professor H. Hacker, Jr., *Chairman* (130 Engineering); Professor Marinos, *Director of Graduate Studies* (173 Engineering); Professors Artley, Kerr, Nolte, Owen, Pilkington, Wang, and Wilson; Associate Professor Joines; Assistant Professor George

A student may specialize in any one of the following fields in working toward either the M.S. or the Ph.D. degree with a major in electrical engineering: solid state materials and devices; ferromagnetics; optical electronics and lasers; instrumentation; electronic systems; microwaves; control theory; energy conversion; digital systems; stochastic systems; and information processing.

Recommended prerequisites for the graduate courses in electrical engineering include a knowledge of basic mathematics and physics, electric networks, and systems theory. Students in doubt about their background for enrollment in specific courses should discuss the matter with the Director of Graduate Studies. The M.S. degree program includes either a thesis or an oral comprehensive examination. A qualifying examination is required for the Ph.D. degree program. These examinations are intended to test both the breadth and depth of the student's understanding of electrical engineering. There is no foreign language requirement.

202. Modeling and Simulation. Modeling of deterministic and random signals, with emphasis on band-limited signals and sampling theorems. Numerical methods for describing the input-output behavior of systems. Simulation of linear

systems using Z-transform, spline component, and state-transition methods. Simulation of nonlinear systems by Runge-Kutta and predictor-corrector methods. Error comparisons for the linear and nonlinear methods. Computer generation of pseudo-random sequences. Numerous computer exercises. Prerequisites: Electrical Engineering 113 or equivalent and computer programming capability. 3 units. *Kerr*

203. Random Signals and Noise. Introduction to mathematical methods of describing and analyzing random signals and noise. Review of basic probability theory; joint, conditional, and marginal distributions; random processes. Time and ensemble averages, correlation, and power spectra. Optimum linear smoothing and predicting filters. Introduction to optimum signal detection and parameter estimation. Fall semester. 3 units. *Kerr or Nolte*

204. Information Theory and Communication Systems. Information and entropy and their application in communication situations. Noise and channel capacity, coding, and the fundamental theorem of information theory. Continuous channels and transmission of band-limited signals. Comparisons of various practical modulation techniques from the standpoint of information rate and error probability. Spring semesters, 1980, 1982. Prerequisite: Electrical Engineering 203. 3 units. *Kerr or Nolte*

205. Signal Detection and Extraction Theory. Introduction to signal detection and information extraction theory from a statistical decision theory viewpoint. Subject areas covered within the context of a digital environment are decision theory, detection and estimation of known and random signals in noise, estimation of parameters and adaptive recursive digital filtering, and decision processes with finite memory. Applications to problems in communication theory. Spring semester. Prerequisite: Electrical Engineering 203 or consent of instructor. 3 units. *Nolte*

206. Digital Signal Processing. Introduction to the fundamentals of processing signals by digital techniques with applications to practical problems. Discrete time signals and systems, elements of the z-transform, discrete Fourier transform, digital filter design techniques, fast Fourier transform, and discrete random signals. Fall semester. 3 units. *Nolte*

207. Fault-Tolerant Computer Systems. Test generation and diagnostic program development for detection and location of faults in digital networks; digital simulation as a diagnostic tool for test generation and verification of the initial system design; design of self-checking and fault-tolerant systems; and effectiveness evaluation of various fault-tolerant schemes. Fall semester. (Also listed as Computer Science 207.) 3 units. *Marinos*

208. Digital Computer Design. Hardware implementation of combinational and sequential switching networks. Arithmetic elements, switching matrices, character generators, counters, and microprocessors. Detailed design and simulation of a general-purpose computer system. Computer architectures based on macromodules, hardware compiler implementations, and parallel processing concepts are also discussed. Prerequisite: Electrical Engineering 157 or consent of instructor. Spring semester. (Also listed as Computer Science 208.) 3 units. *Marinos*

211. Solid State Theory. A treatment of postulatory quantum mechanics and statistical mechanics to serve as a background for the solid state sciences. Topics include both the Schrodinger and matrix formulations, angular momentum, perturbation methods, Maxwell-Boltzmann and Fermi distributions. Prerequisite: consent of instructor. Fall semester. 3 units. *Hacker*

212. Solid State Materials. Concepts of solid state physics as applied to engineering materials; electric magnetic, thermal, and mechanical properties of solids; dielectrics; semiconductors; magnetic materials; superconductors. Prerequisite: Electrical Engineering 211. Spring semester. 3 units. *Hacker*

213. Principles of Magnetism. A discussion of the various classes of magnetic materials including diamagnets, paramagnets, ferromagnets, antiferromagnets, and ferrimagnets. Typical topics include: crystal field effects, exchange interactions, domain formation, and resonance phenomena. Prerequisite: consent of instructor. 3 units. *Artley or Hacker*

215. Semiconductor Physics. A quantitative treatment of the physical processes that underlie semiconductor device operation. Topics include: band theory and conduction phenomena; equilibrium and nonequilibrium charge carrier distributions; charge generation, injection, and recombination; drift and diffusion processes. Prerequisite: Electrical Engineering 211 or consent of instructor. 3 units. *Hacker*

217. Lasers. Principles of lasers. Discussion of quantum electronics, optical configuration; solid state, gaseous, and liquid devices; modulation; high power operation. Some laboratory work. Prerequisite: consent of instructor. Spring semester, 1979. 3 units. *George or Lontz*

222. Nonlinear Analysis. Introduction to methods of analyzing engineering systems described by nonlinear differential equations: analytic, numerical, graphical, and series approximation methods; analysis of singular points; stability of nonlinear systems. Applications of various methods, such as the modified Euler, Runge-Kutta, isoclines, perturbation, reversion, variation of parameters, residuals, harmonic balance, Bendixon, and Liapounov to phenomena of nonlinear resonance, subharmonics, relaxation oscillations, and forced oscillating systems. Fall semester. (Also listed as Mechanical Engineering 232.) 3 units. *Wilson*

224. Integrated Electronics. Application of integrated circuits for analog and digital systems. Topics include the effect of fabrication techniques on circuitry design, a study of differential and operational amplifiers, feedback, and consideration of various logic families such as resistor-transistor logic (RTL), diode-transistor logic (DTL), current-mode or emitter-coupled logic (ECL), and transistor-transistor logic (TTL). Prerequisite: Electrical Engineering 161 or equivalent. Fall semester. 3 units. *Wilson*

225. Semiconductor Electronic Circuits. Analysis and design of electronic circuits utilizing a variety of static and dynamic models of semiconductor devices. Transistor and other semiconductor device circuit models; bias stability; high frequency and noise models; switching characteristics; illustrative semiconductor circuits. Selected laboratory work. Spring semester. Prerequisite: consent of instructor. 3 units. *Joines*

226. Modeling and Computer-Aided Analysis of Electronic Systems. Modeling of linear and nonlinear components and devices. Network topology, including nodal and state variable formulations. Sparse matrix techniques for nodal formulations; explicit and implicit integration techniques for state variable formulations. Algorithms for computer-aided analysis. Selected projects. Prerequisite: Electrical Engineering 103 or 161, or equivalent. Spring semester. 3 units. *Owen*

227. Network Synthesis. Linear network theory, including a review of time and frequency domain analysis; network graphs; network functions and realizability condition; driving point impedance synthesis of passive networks; driving

point and transfer specifications; approximation methods. Prerequisite: consent of instructor. 3 units. *George*

231. Energy Systems. A comprehensive treatment of the general concepts of storage, transfer, transformation, and control that are applicable to a variety of technical systems with emphasis on their common mathematical structure. Attention is given to the human use of energy for personal, industrial, and commercial purposes. Economic and social factors as well as scientific factors are considered. Fall semester. 3 units. *Artley*

234. Power Electronics: High-Power Circuits. Basic principles of analysis and design of electronic power control and conversion circuits with particular emphasis on thyristor circuits. Characteristics of high-power semiconductors, commutating circuits, ac voltage controllers, ac-to-dc controlled rectifiers, dc-to-dc converters, dc-to-ac inverters, ac-to-ac converters. Prerequisite: Electrical Engineering 161 or equivalent. Spring semester. 3 units. *Wilson and Owen*

235. Nonlinear Magnetic and Semiconductor Power Converters: Design and Control I. Engineering properties of modern soft magnetic materials. Mathematical descriptions of nonlinear magnetic and semiconductor characteristics for transient and steady-state analysis of power electronic circuits. Design of saturable and nonsaturating magnetic devices. State-plane analysis of negative-resistance oscillators and self-oscillating dc-to-ac inverters. Considerations of starting problems, semiconductor switching losses, magnetic core losses, and efficiency. Prerequisites: Electrical Engineering 161 or equivalent and consent of instructor. Fall semester. 3 units. *Wilson and Owen*

236. Nonlinear Magnetic and Semiconductor Power Converters: Design and Control II. Analysis, design, and control of electronic dc-to-dc power converters utilizing energy storage principles. Optimum configurations, stability, losses, large-signal and small-signal dynamic response, measurement techniques. Special attention given to design of pulse modulated controllers using state-space and frequency-response techniques. Prerequisite: Electrical Engineering 235. Spring semester. 3 units. *Owen and Wilson*

237, 238. Advanced Power Electronics Laboratory and Seminar. Experiments related to the design, control, measurement, and application of power electronic circuits and systems. Prerequisite: consent of instructor. Fall and spring semesters. 3 units each semester. *Owen and Wilson*

241. Linear Systems. Modeling of multiple input-output linear systems in the frequency and time domains. Matrix differential and difference equations and their solutions; state variables. Digital simulation of differential systems. Fourier analysis of signals and systems. Transform techniques applied to state variable models. State space models of distributed systems. Fall semester. 3 units. *Wang or Kerr*

242. Modern Control and Dynamic Systems. See course description for Mechanical Engineering 230. (Also listed as Mechanical Engineering 230.) 3 units. *Wright*

243. Advanced Linear Systems Theory. Linear spaces and linear operators. Impulse-response matrices. Controllability and observability. Irreducible realizations of rational transfer function matrices. Canonical forms, state estimators, and observer theory. Stability. Linear time-invariant composite systems. Prerequisite: Electrical Engineering 241. Spring semesters, 1980, 1982. 3 units. *Wang*

251. Pattern Classification and Recognition. Parameter estimation and supervised learning; nonparametric techniques; linear discriminant functions; clus-

tering; language theory related to pattern recognition and syntactic pattern recognition; examples such as characters, severe weather recognition and classification of community health data, etc., are discussed. Prerequisite: consent of instructor. Spring semesters, 1980, 1982. 3 units. *Wang*

252. Computer Systems Organization. Hardware and software aspects. Processor, memory, device, and communication subsystems; case studies of hardware system organization, e.g., parallel, associative, fault-tolerant; organization of software systems to exploit hardware systems organization; economic and reliability aspects of various hardware organizations. Prerequisites: Computer Science 150 and 157. (Also listed as Computer Science 252). 3 units. *Trivedi*

265. Advanced Topics in Electrical Engineering. Opportunity for study of advanced subjects related to programs within the electrical engineering department tailored to fit the requirements of a small group. Prerequisites: approval of the Director of Graduate Studies and of instructor under whom work will be done. 1 to 3 units. *Staff*

266. Biofeedback Systems. Instrumentation, on-line computer analysis, and models associated with biofeedback systems. Selected readings will be considered in conjunction with experience in laboratory feedback practices. The physical, physiological, and psychological aspects of biofeedback provide a vehicle for experiential learning which relates individual experience to models used in systems theory, field theory, electronics, and communications. Prerequisite: consent of instructor. Spring semester. 3 units. *Artley*

271. Electromagnetic Theory. The classical theory of Maxwell's equations; electrostatics, magnetostatics, boundary value problems including numerical solutions, currents and their interactions, and force and energy relations. Three class sessions. Fall semester. Prerequisite: consent of instructor. 3 units. *Joines or Hacker*

272. Application of Electromagnetic Theory. Propagation of electromagnetic waves in various structures and media; mathematical description of microwave networks, including equivalent circuits and matrix methods; microwave circuit theorems and synthesis techniques. Selected laboratory experiments. Spring semesters, 1980, 1982. Prerequisite: Electrical Engineering 271. 3 units. *Joines*

297-298. Thesis Research. 6 units. *Staff*

304. Estimation, Filtering, and Random Systems. Statistical estimation and filtering techniques applied to signal analysis and system identification. Weiner and Kalman filter theory in the estimation of system state variables and system parameters. Statistical treatment of linear random operators and random differential equations. Applications to communications and control with selected computer exercises. Prerequisite: Electrical Engineering 203. Spring semester. 3 units. *Kerr*

305. Advanced Applications of Statistical Decision Theory. Optimum modulators and demodulators, comparison of various systems. Gaussian signals in Gaussian noise; sonar-radar problem, representation of narrow band processes, slowly fluctuating targets, optimum receiver for estimating range and Doppler, properties of autocorrelation functions and ambiguity functions, pseudorandom signals, resolution, frequency spreading, reverberation, active sonar, optimum space-time system, and passive sonar. Prerequisite: Electrical Engineering 205. Fall semesters, 1980, 1982. 3 units. *Nolte*

306. Adaptive Detection and Communication Systems. Sequential detection, Wald's sequential probability ratio test, sequential tests of composite hypotheses, deferred decision theory; adaptive systems, nondecision directed and

decision directed measurements, adaptive on-off communications systems, transmitted reference systems, detection systems employing the learning feature, learning with and without a teacher, pattern recognition. Applications to communication systems. Prerequisite: Electrical Engineering 205. Fall semester, 1979. 3 units. *Nolte*

308. Advanced Topics in Digital Systems. A selection of advanced topics of current research interest to the instructor and the class from the areas of digital computer architectures and fault-tolerant computer design. Spring semester. (Also listed as Computer Science 308.) 3 units. *Marinos*

313. Magnetic Processes in Materials.* Selected topics in magnetism. Cryomagnetics, spin wave resonance, interaction of superconductor and ferromagnetic materials, nonlinear spin wave theory, effects of finite dimensions and interfaces on basic properties of ferromagnets. Microwave applications. Prerequisite: Electrical Engineering 213 or consent of instructor. 3 units. *Hacker*

317. Quantum Electronics. Principles of optical fields and light-matter interactions concerned with the generation, propagation, detection, modulation, and control of optical radiation in atomic systems. Topics include optical Gaussian beams and guided-wave propagation, important optical and laser media, the electro-optic effect, the photo-elastic effect, nonlinear optics theory, parametric oscillation, Bragg and Brillouin scattering, dielectric optical waveguides and associated phenomena. Prerequisites: Electrical Engineering 211 and 271, or consent of instructor. Spring semester, 1979. 3 units. *Staff*

324. Nonlinear Oscillations in Physical Systems. Analysis of phenomena encountered in free and forced oscillating systems: stability criteria, topological methods, degenerate systems and discontinuous theories, relaxation oscillations, asymptotic approaches. Emphasis on interdependence of physical and mathematical reasoning in analyzing nonlinear electrical and mechanical systems. Illustrative examples selected to meet interests of class. Prerequisite: Electrical Engineering 222. Spring semesters, 1980, 1982. 3 units. *Wilson*

342. Optimal Control Theory. Optimization problems for dynamic systems. Optimal feedback control. Linear systems with quadratic criteria; mathematical programming; optimal filtering and prediction; optimal feedback control in the presence of uncertainty. Prerequisite: Electrical Engineering 241. Spring semester, 1979. 3 units. *Wang*

371. Advanced Electromagnetic Theory.* An advanced treatment of topics in electromagnetic theory selected from the interests of the instructor and students. Representative topics are propagation in anisotropic media, plasma waves, antennas, and boundary value problems. Prerequisite: Electrical Engineering 272. 3 units. *Joines or Hacker*

373. Selected Topics in Field Theory.* An advanced treatment of topics in generalized field theory selected from the interests of the instructor and the students. Representative topics are generalized fields, electromagnetic interactions, quantum electrodynamics, inhomogeneous media, and diffusion phenomena. Prerequisite: Electrical Engineering 272. 3 units. *Artley or Joines*

399. Special Readings in Electrical Engineering. Special individual readings in a specified area of study in electrical engineering. Prerequisite: approval of the Director of Graduate Studies. 1 to 3 units. *Graduate staff*

*Offered on demand.

MECHANICAL ENGINEERING AND MATERIALS SCIENCE

Professor Chaddock, *Chairman* (142 Engineering); Professor Cocks, *Director of Graduate Studies* (227 Engineering); Professors Clark, Garg, Harman, and Pearsall; Adjunct Professor Roberts; Associate Professors Elsevier, Shepard, and Wright; Adjunct Associate Professor Mayer; Assistant Professors Buzzard, Hight, Johnson, Jones, and Shaughnessy; Adjunct Assistant Professor Sud

Graduate study is available to students seeking the M.S. and Ph.D. degrees with a major in either mechanical engineering or materials science. Departmental programs of advanced study and research include photovoltaics, control systems, dynamics and vibrations, energy conversion, fluid mechanics, heat and mass transport, mechanical design, thermodynamics, physical metallurgy, corrosion, fracture, and polymer science. The faculty cooperates with faculty members from a number of other departments and schools to establish interdisciplinary research projects and programs of study in areas which include applied mechanics, biomechanics, biomedical materials, environmental quality and control, ocean engineering, systems engineering, engineering and public policy, and transportation systems.

The program includes the opportunity for experimental work as well as theoretical study. A major emphasis is placed upon developing the research ability of the student and relating the program to the evolving needs of modern engineering practice.

202. Engineering Thermodynamics. Review of classical thermodynamics. Thermodynamics of continuum properties of real substances. Analysis of energy conversion with internal irreversibility and advanced engineering problems. Introduction to the statistical basis of thermodynamics. 3 units. *Harman*

209. Structural Dynamics. (Also listed as Civil Engineering 209.) 3 units. *J. F. Wilson*

210. Intermediate Dynamics. Comprehensive treatment of space kinematics, kinetics of particles and rigid bodies; generalized coordinates and Lagrange's equations; introduction to stability and random dynamic analysis of flexible, continuous systems. (Also listed as Civil Engineering 210.) 3 units. *J. F. Wilson*

211. Theoretical and Applied Polymer Science. An advanced course in materials science and engineering, dealing specifically with the structure and properties of polymers. Particular attention is paid to recent developments in the processing and use of modern plastics and fibers. Product design is considered in terms of polymer structures, processing techniques, and properties. 3 units. *Clark or Pearsall*

213. Advanced Materials Science. An in-depth study of current problems in materials applications conducted in a seminar format. Treatment will include thermal, electrical, optical, and magnetic properties of materials in terms of basic physical concepts. Subjects intended to provide materials scientists and engineers with a theoretical basis for understanding and manipulating properties. Prerequisites: Engineering 83 and Mechanical Engineering 111 or 112. 3 units. *Cocks or Shepard*

214. Corrosion and Corrosion Control. Effects of environments on the design and utilization of modern engineering alloys. Theory and mechanisms of corrosion, particularly in seawater and atmospheric environments. Microstructural aspects of diffusion, oxidation, hot corrosion, and stress corrosion. Prerequisite: Engineering 83. 3 units. *Cocks or Jones*

216. Materials Design and Resource Conservation. The role of materials science and engineering in the field of resource conservation and recovery.

Selection of materials for components of consumer products and equipment. Designing materials at atomic, molecular, and phase-structure levels to minimize energy consumption, optimize properties, and enhance recycling. Analysis of some constraints posed by thermodynamics, economics, raw material availability, and governmental policies. Prerequisite: Engineering 83. 3 units. *Pearsall*

221. Compressible Fluid Flow. Basic concepts of the flow of gases from the subsonic to the hypersonic regime. Effects of friction, heat transfer, and shock on one-dimensional inviscid flow. Potential theory, oblique shock waves, and special calculation techniques in two-dimensional flow. 3 units. *Buzzard or Shaughnessy*

222. Heat Transfer. Steady-state and transient solutions of the general heat conduction equation. Development of the equations for transport of energy by fluid motion. Principles of similarity and dimensional analysis in convective energy transport. Solutions of the boundary layer equations. The laws of radiation heat transfer and radiation heat exchange. 3 units. *Chaddock or Buzzard*

223. Principles and Design of Heat Transfer Equipment. Application of theoretical and experimental developments in heat transfer to the design of heat exchangers. Study of fin shapes, finned passages, fouling factors, baffling and other parameters of heat exchanger design. Analytical and numerical methods for design calculation illustrated with equipment such as: furnaces, recuperators, regenerators, solar collectors, condensers, and evaporators. Prerequisite: Mechanical Engineering 150. 3 units. *Chaddock or Johnson*

224. An Introduction to Turbulence. Flow instability and the transition to turbulence. Physical characteristics of turbulent flows, averaging, and the Reynolds equation. Turbulent transport and mixing length theories. The statistical description of turbulence, correlations, and spectra. Fourier transforms. Measurement techniques. 3 units. *Shaughnessy*

226. Intermediate Fluid Mechanics. A survey of the principal concepts and equations of fluid mechanics. Fluid properties. Statics. Basic equations for the control volume. The differential equations of fluid motion. Stream function. Irrotational flow. Navier-Stokes equations. Kelvin's and Crocco's theorem. Applications to two-dimensional incompressible potential flow and to viscous flow in boundary layers. 3 units. *Shaughnessy*

227. Advanced Fluid Mechanics. Flow of a uniform incompressible viscous fluid. Exact solutions to the Navier-Stokes equation. Similarity methods. Irrotational flow theory and its applications. Elements of boundary layer theory. Prerequisite: ME 226, or consent of instructor. 3 units. *Shaughnessy*

230. Modern Control and Dynamic Systems. Dynamic modeling of complex linear and nonlinear physical systems involving the storage and transfer of matter and energy. Unified treatment of active and passive mechanical, electrical, and fluid systems. State space formulation of physical systems. Time and frequency-domain representation. Controllability and observability concepts. System response using analytical and computational techniques. Lyapunov method for system stability. Modification of system characteristics using feedback control and compensation. Introduction to optimal control using Euler-Lagrange and Pontryagin's formulations. Emphasis on application of techniques to physical systems. (Also listed as Electrical Engineering 242.) 3 units. *Garg or Wright*

231. Systems Response and Control. Methods, applicable to design, of obtaining parameters for strength, response, and stability studies to mechanical systems. Analysis of closed loop control systems with linear transfer functions;

electrical and mechanical analogs; introduction to determination of transfer function from input-output characteristics. 3 units. *Wright*

232. Nonlinear Analysis. Fall semesters. Prerequisite: consent of instructor. (Also listed as Electrical Engineering 222.) 3 units. *T. Wilson*

235. Advanced Mechanical Vibrations. Analytical and experimental procedures applied to design of machines and systems for adequate vibration control. Determination of eigenvalues and eigenvectors by iteration and computer techniques; transfer matrices applied to lumped and distributed systems; analytical and numerical methods of obtaining the pulse response of plane and three dimensional multi-mass systems; convolution and data processing; introduction to random vibration. 3 units. *Wright*

236. Engineering Acoustics and Noise Control. Specification of the physical properties of noise, noise measurement, and absorption, transmission, and propagation of sound. Effects of noise on man, noise exposure, and damage risk criteria. Legal aspects of noise control, source modification, enclosures, barriers, and personnel protectors. Prerequisites: Mechanical Engineering 123 and Mathematics 111. 3 units. *Wright*

254. Solar Energy Thermal Processes. Solar radiation instrumentation, measurements, data, and estimation. Radiation heat transfer characteristics of opaque materials and partially transparent media. Performance and design calculations for flatplate and focusing collectors. Thermal energy storage. Solar water heating and heating and cooling of buildings. Economics and lifecycle costing studies for solar installations. Survey of research, development, and demonstration projects on solar thermal processes. 3 units. *Chaddock*

265. Advanced Topics in Mechanical Engineering. Opportunity for study of advanced subjects related to programs within mechanical engineering tailored to fit the requirements of a small group. Prerequisites: approval of the Director of Undergraduate or Graduate Studies and the instructor under whom work will be done. 1 to 3 units. *Staff*

273. Ocean Engineering. Application of classical engineering disciplines to components and systems operating in the marine environment. Topics include marine corrosion, hydrodynamics and stability of vessels, marine power systems, man-rated pressure vessel and submersible design. Engineering concepts applied to the physiology and mechanics of diving and marine related energy resources. Prerequisite: Mechanical Engineering 101 or equivalent. 3 units. *Johnson*

280. Nuclear Reactor Power Cycles. Basic reactor principles and types. Examination of most feasible thermodynamic cycles for use with both stationary and mobile power plants. Consideration of safety shielding, heat transfer, fluid flow, and materials problems unique to reactor design. 3 units. *Staff*

300. Advanced Projects in Mechanical Engineering. This course may be elected by students enrolled in a nonthesis program leading to the Master of Science degree. 3 units. *Graduate staff*

302. Advanced Thermodynamics. Classical thermodynamics of inherently irreversible processes. Quantum and statistical thermodynamic analysis of properties of real substances and processes. Principles of general thermodynamics. 3 units. *Harman*

311. Behavior of Crystalline Solids. An advanced treatment of the dependence of structure on atomic bonding, and of properties on structure in crystalline solids. Crystal structures; phase diagrams and solid-state thermodynamics; physi-

cal properties; mechanical properties; kinetics of thermal treatments. 3 units. *Pearsall or Shepard*

321. Gas Dynamics. Thermodynamic concepts and elements of one dimensional compressible flow. Waves in supersonic flow. Equations of frictionless flow and small perturbation theory. Bodies of revolution, slender body theory, and the similarity rules of high speed flow. The method of characteristics. Low density flow. 3 units. *Shaughnessy or Buzzard*

322. Mechanics of Viscous Fluids. Equations of motion for a viscous fluid; general properties and selected solutions of the Navier-Stokes equations; laminar boundary layer equations with selected solutions and approximate techniques; origin of turbulence. 3 units. *Buzzard or Shaughnessy*

323. Convective Heat Transfer. Models and equations for fluid motion, the general energy equation, and transport properties. Exact, approximate, and boundary layer solutions for laminar flow heat transfer problems. Use of the principle of similarity and analogy in the solution of turbulent flow heat transfer. Two-phase flow, nucleation, boiling, and condensation heat and mass transfer. Prerequisite: Mathematics 285. 3 units. *Chaddock*

324. Conduction and Radiation Heat Transfer. Conduction heat transfer in steady and transient state. Radiation exchange involving absorbing and emitting media including gases and flames, combined conduction and radiation and combined convection and radiation. Exact and approximate methods of solution including separation of variables, transform calculus, numerical procedures, and integral and variational methods. Prerequisites: Mathematics 285 and Mechanical Engineering 222 or equivalent. 3 units. *Buzzard or Chaddock*

327. Homogeneous Turbulence. Stochastic methods in turbulence theory. The kinematics of homogeneous turbulence. The dynamics of decay, universal equilibrium theory, and probability distribution of velocity. 3 units. *Shaughnessy*

328. Turbulent Shear Flow. The Reynolds equation and the energy balance. Turbulent transport processes. Flow in channels and pipes. The turbulent boundary layer. Free turbulence: jets, wakes, and mixing layers. Recent theoretical and experimental work. 3 units. *Shaughnessy*

331. Nonlinear Control Systems. Analytical, computational, and graphical techniques for solution of nonlinear systems; Krylov and Bogoliubov asymptotic method; describing function techniques for analysis and design; Liapounov functions and Lure's methods for stability analysis; Aizerman and Kalman conjectures; Popov, circle, and other frequency-domain stability criteria for analysis and synthesis. Prerequisite: Mechanical Engineering 230 or consent of instructor. 3 units. *Garg or Wright*

333. Seminar in Control Systems. Modern developments from the areas of system dynamics, linear, nonlinear, and optimal control; computational techniques for system analysis and synthesis; emphasis on recently published writing in the controls field; topics to be selected to match the interests of the student group; term paper required. Prerequisite: knowledge of basic linear control theory or computer programming, or consent of instructor. 3 units. *Garg*

335. Analytical Methods in Vibrations. Time and frequency domain analysis, generalized coordinates and Lagrange's equations, natural modes of continuous systems, approximate methods, damped systems, introduction to random vibrations. Prerequisite: Mechanical Engineering 235 or consent of instructor. 3 units. *Wright*

372. Finite Element Techniques in Design. Finite element methods applied to design problems in stress analysis; temperature distribution; and flow problems. Derivation of state vectors and transfer matrices for rectangular and triangular elements; accuracy and computation methods; comparison with difference equation methods and available analytical results. 3 units. *Staff*

399. Special Readings in Mechanical Engineering. Individual readings in advanced study and research areas of mechanical engineering. Prerequisite: approval of the Director of Graduate Studies. 1 to 3 units. *Graduate faculty*

English

Professor Budd, *Chairman* (323 Allen); Professor Nygard, *Director of Graduate Studies* (316 Allen); Professors Anderson, Cady, Duffey, Ferguson, Gleckner, Randall, Reiss, Ryals, Smith, Turner, G. Williams, and K. Williams; Associate Professors Butters, DeNeef, Gerber, Jackson, Jones, Mellow, Monsman, and Strandberg

The department offers graduate work leading to the A.M., M.A.T., and Ph.D. degrees. A statement of the requirements for the A.M. and Ph.D. degrees may be obtained from the Director of Graduate Studies. The department requires a reading knowledge of one foreign language for the A.M. degree; for the Ph.D. degree, two languages determined by the student's committee.

For Seniors and Graduates

207. Old English Grammar and Readings. (Also listed under Medieval and Renaissance Studies.) 3 units. *Nygard or Reiss*

208. History of the English Language. Introductory survey of the changes in sounds, forms, and vocabulary of the English language from its beginning to the present, with emphasis on the evolution of the language as a medium of literary expression. (Also listed under Medieval and Renaissance Studies.) 3 units. *Nygard or Reiss*

209. Present-Day English. A description of present-day American English from the point of view of modern linguistic theory; comparison of traditional and structural grammars; semantic change; the relation of the written to the spoken language; usage. 3 units. *Butters, Nygard, or Reiss*

210. Old English Literary Tradition. Prerequisite: English 207. (Also listed under Medieval and Renaissance Studies.) 3 units. *Nygard or Reiss*

212. Middle English Literary Tradition. From 1100 to 1500 (excluding Chaucer); medieval genres; reading of selected texts. A reading knowledge of Middle English is recommended. (Also listed under Medieval and Renaissance Studies.) 3 units. *Nygard or Reiss*

215. Chaucer. *The Canterbury Tales*. (Also listed under Medieval and Renaissance Studies.) 3 units. *Nygard or Reiss*

216. Chaucer. *Troilus and Criseyde* and the minor poems. (Also listed under Medieval and Renaissance Studies.) 3 units. *Nygard or Reiss*

221. English Prose and Poetry of the Sixteenth Century. Readings in the major nondramatic forms and authors; from Sir Thomas More to John Donne. (Also listed under Medieval and Renaissance Studies.) 3 units. *DeNeef*

223. Spenser. (Also listed under Medieval and Renaissance Studies.) 3 units. *DeNeef*

224. Shakespeare. The plays. (Also listed under Medieval and Renaissance Studies.) 3 units. *G. Williams*

225, 226. Tudor and Stuart Drama, 1500-1642. First semester: Peele, Lyly, Greene, Kyd, Dekker, Heywood, Chapman, and Marston, with emphasis on Marlowe. Second semester: Jonson, Webster, Beaumont, Fletcher, Massinger, Middleton, Ford, and Shirley. (Also listed under Medieval and Renaissance Studies.) 3 units each semester. *Randall*

229, 230. English Literature of the Seventeenth Century. First semester: prose and poetry from 1600 to 1660. Second semester: prose, poetry, and drama from about 1660 to 1700. 3 units each semester. *DeNeef (229), Jackson (230), Randall (229, 230), or G. Williams (229)*

232. Milton. Milton's poetry and prose, with emphasis on the major poems. (Also listed under Medieval and Renaissance Studies.) 3 units. *Staff*

234. English Drama, 1642-1800. The heroic play and comedy of manners of the Restoration; the important plays, serious and comic, of the eighteenth century. 3 units. *Jackson*

235, 236. The Eighteenth Century. First semester: Swift, Pope, Defoe, Addison, Steele, and others. Second semester: Gray, Johnson, Boswell, Collins, Goldsmith, the novelists, and other writers. 3 units each semester. *Ferguson or Jackson*

241, 242. English Literature of the Early Nineteenth Century. First semester: poets and prose writers, 1790-1810, with emphasis on Wordsworth and Coleridge. Second semester: 1810-1830, with emphasis on Byron, Shelley, and Keats. 3 units each semester. *Gleckner or Monsman*

245, 246. English Literature of the Later Nineteenth Century. First semester: Carlyle, Dickens, Thackeray, Tennyson, and Browning. Second semester: Arnold, Ruskin, Pater, George Eliot, Meredith, the Pre-Raphaelites, and Swinburne. 3 units each semester. *Monsman or Ryals*

251, 252. English Literature of the Twentieth Century. Representative work of leading writers from 1900 to 1950, in fiction, drama, and poetry. First semester: Shaw, Conrad, Yeats, Wells, Bennett, Galsworthy, Ford, Synge, Forster, and Lawrence. Second semester: Joyce, Woolf, Edith Sitwell, Eliot, Huxley, Graves, Bowen, Auden, and Dylan Thomas. Critical analysis of selected texts, with discussion of techniques and ideas. 3 units each semester. *Mellown or Smith*

263, 264. American Literature, 1800-1865. Emphasized in the first semester are Emerson, Thoreau, and Hawthorne; in the second semester, Poe and Melville. 3 units each semester. *Anderson, Jones, or Turner*

267, 268. American Literature, 1865-1915. Selected works of representative authors. First semester: Whitman, Mark Twain, James, Howells, Dickinson, and the Local Colorists. Second semester: Crane, Norris, Dreiser, Cather or Wharton, O'Neill, Robinson, and Frost. 3 units each semester. *Budd, Cady, or K. Williams*

270, 271. Southern Literature. Emphasis in the first semester is on Byrd, Kennedy, Simms, Poe, Timrod, and the humorists; in the second, on Lanier, Harris, Cable, Twain, Glasgow, and Faulkner. 3 units each semester. *Turner*

275, 276. American Literature since 1915. First semester: selected fiction from Gertrude Stein to the present. Second semester: poetry from the Imagist movement to the present. 3 units each semester. *Duffey or Strandberg*

280. Introduction to Folklore. A survey of the materials of popular tradition, the folksong, the folktale, the proverb, the riddle, and other forms; the methods of

folklore investigation; and the relation of these popular genres to literary tradition. 3 units. *Nygard*

285. Literary Criticism. Readings from the major critics, Plato to the eighteenth century, with emphasis on formative ideas and historical continuity. 3 units. *Jackson*

287. Theory of Literature from Kant to the Present. A survey of the literary theory; intellectual currents of Romanticism, the classic revival, the realistic schools, symbolism, and the recent analytic school. 3 units. *Duffey*

For Graduates

310. Beowulf. Reading and interpretation of the text. (Also listed under Medieval and Renaissance Studies.) 3 units. *Nygard*

312. Studies in Middle English Literature. English literature from 1100 to 1500 (excluding Chaucer); a study of medieval genres with a close reading of selected major works. (Also listed under Medieval and Renaissance Studies.) 3 units. *Nygard or Reiss*

315. Studies in Chaucer. (Also listed under Medieval and Renaissance Studies.) 3 units. *Nygard or Reiss*

318. Medieval Romances. Origins, types, forms, themes; special attention to Arthurian materials. (Also listed under Medieval and Renaissance Studies.) 3 units. *Reiss*

320. Studies in Renaissance English Prose. Close readings in various forms and authors as they reflect the culture and thought of the Renaissance. (Also listed under Medieval and Renaissance Studies.) 3 units. *Staff*

324. Studies in Shakespeare. Intensive study of carefully limited topics, together with critical analysis and interpretation of selected texts. (Also listed under Medieval and Renaissance Studies.) 3 units. *G. Williams*

325. Studies in the English Drama of the Sixteenth and Seventeenth Centuries. (Also listed under Medieval and Renaissance Studies.) 3 units. *Randall*

329. Studies in the Metaphysical Poets. A careful study of Donne, Herbert, and Vaughan against the seventeenth-century background, with some attention to their influence on other writers in the period and their impact on twentieth-century poetry. (Also listed under Medieval and Renaissance Studies.) 3 units. *DeNeef or G. Williams*

330. Studies in Dryden and His Age. The early poems, the important odes, the religious and political poems, selected critical and controversial prose, and the heroic play and tragedy. 3 units. *Jackson*

337. Studies in English Augustanism. Intensive study of the major prose; selected readings in the verse, political writings, and miscellaneous prose. 3 units. *Ferguson or Jackson*

338. Studies in the Age of Johnson. 3 units. *Ferguson*

339. The Eighteenth-Century Novel. Richardson, Fielding, Smollett, and Sterne are emphasized. Attention is given to earlier prose fiction and to other contributing literary patterns. 3 units. *Ferguson or Jackson*

341. Studies in English Romanticism. 3 units. *Gleckner or Jackson*

347. Studies in Victorian Poetry. 3 units. *Monsman or Ryals*

- 348. Studies in Victorian Fiction.** 3 units. *Ryals*
- 353. Studies in British Poetry of the Twentieth Century.** Detailed examination of major poetic texts with background readings in prose. 3 units. *Smith*
- 354. Studies in British Prose of the Twentieth Century.** Intensive study of the writings, both fiction and nonfiction of one major British author. 3 units. *Mellown or Smith*
- 361. Studies in a Major American Author of the Early Nineteenth Century.** 3 units. *Anderson, Jones, or Turner*
- 362. Studies in a Major American Author of the Later Nineteenth Century.** 3 units. *Budd, Cady, or K. Williams*
- 364. Hawthorne and Melville.** Extensive reading in the works of Hawthorne and Melville, and close study of selected writings. 3 units. *Turner or Jones*
- 368. Studies in American Realistic Fiction.** Intensive study of a post-Civil War novelist such as Howells, with lesser attention to a representative precursor such as De Forest, and a twentieth-century writer such as Dreiser. 3 units. *Budd or Cady*
- 369. Studies in American Humor.** The native tradition in the Down-East humorists and the humorists of the Old Southwest, in Mark Twain and his contemporaries, and afterward. 3 units. *Turner*
- 375. Studies in American Poetry of the Twentieth Century.** 3 units. *Duffey*
- 376. Studies in American Prose of the Twentieth Century.** 3 units. *Duffey*
- 380. The Traditional Ballad and Folksong.** Studies in English, Scottish, and American popular poetry, with attention to the textual and musical traditions. No technical knowledge of music is required. 3 units. *Nygard*
- 383. Textual Criticism.** The principles of analytical bibliography and their application to problems and procedures in the study of Elizabethan printed books. (Also listed under Medieval and Renaissance Studies.) 3 units. *G. Williams*
- 387. Special Topics Seminar.** 3 units. *Staff*
- 390. Seminar in the Teaching of Composition.** Open to newly appointed tutors in English during their first semester of teaching; admission also by consent of instructor. No grade. 3 units. *Staff*

TUTORIALS

Specialized subjects of study will be offered, numbered in the 390's, to accommodate the interests of advanced graduate students. Tutorials will be offered to single students or to small groups. Instruction will be conducted in weekly sessions, or in more frequently scheduled sessions, if the instructor wishes. Emphasis will be on independent reading and investigation, and oral and written reports. A substantial amount of writing will be required.

Students are advised to consult the Director of Graduate Studies for a list of tutorials currently scheduled to be offered. 3 units. *Staff*

Forestry and Environmental Studies

Professor Benjamin Jayne, *Dean* (216 Biological Sciences); Professor Barnes, *Director of Graduate Studies* (309 Biological Sciences); Professors Anderson, Hellmers, Joerg,

Knoerr, Philpott, Ralston, Stairs, and Stambaugh; Adjunct Professor Hart; Associate Professors Convery, Richardson, Vesilind, and Yandle; Adjunct Associate Professors Dutrow and Metz; Assistant Professors Rajagopal and Thompson; Adjunct Assistant Professor Vasievich; Instructor and Research Associate Royer

Major and minor work is offered in the areas of natural resource science, management, and policy; leading to the Master of Arts, Master of Science, and Doctor of Philosophy degrees. College graduates who have a bachelor's degree in one of the natural or social sciences, forestry, engineering, business, or environmental science will be considered for admission to a degree program. Students will be restricted to the particular fields of specialization for which they are qualified academically. Graduate School programs usually concentrate on some area of natural resource science or policy, while study in resource management is more commonly followed in one of the professional master's degree programs of the School of Forestry and Environmental Studies. For information on professional training in forestry or environmental studies, the *Bulletin of the School of Forestry and Environmental Studies* should be consulted.

The specific degrees available in forestry and related natural resources through the Graduate School are: the A.M. (with or without a thesis), M.S. (with a thesis), and the Ph.D. Students majoring in forestry or environmental studies may be required to demonstrate satisfactory knowledge of one or two foreign languages for the Ph.D. degree. More information on degree and language requirements can be found in the Program Information section of the bulletin.

RESOURCE SCIENCE

203. General Meteorology. A general introduction to the science of meteorology, particularly for students concerned with problems in biology and hydrology. Emphasis is placed on the fundamentals and role of atmospheric thermodynamics and energy and mass transfer processes in determining both local and regional aspects of weather and climate. 3 units. *Knoerr*

204. Microclimatology. Introduction to the micrometeorological processes. Discussion of the integration of these processes and the resulting microclimates in the rural (forest, field, and water surface) and urban environments. Methods for modification of the microclimate. 3 units. *Knoerr*

206. Anatomy of Woody Plants. Primary and secondary structures in seedlings and in mature trees, shrubs, and vines. Preparation techniques for gross observations, and for study of micro and ultrastructures with light and electron microscopy. Relationship of microstructures to growth habits and physical properties of woody plant parts. Comparative studies in relation to ecological and systematic topics. Prerequisite: college botany or biology. 4 units. *Philpott*

209. Tree Biology. Life processes and properties of trees, including anatomical, developmental, physiological, and chemical considerations. Emphasis on structure in relation to function in the tree, and to uses of tree-derived products. 3 units. *Barnes*

211. Resource Ecology and Ecosystem Analysis. An introduction to ecological principles with an emphasis on the ecosystem as a basic working unit. Perspectives include such topics as land/water interactions, the patchiness concept, succession, energy flow, productivity, mineral cycling, perturbation effects on ecosystems, microclimate, and limiting factors. Field studies will focus on the team approach to analyzing the biotic and abiotic components of the ecosystem and the effects of human use. 3 units. *Richardson*

212. Population Ecology. Discussion of population dynamics of natural and exploited populations. A quantitative approach with an emphasis on mathematical models and their application to population problems. 3 units. *Thompson*

216. Watershed Hydrology. Influence of vegetation, soil types, and land forms on water yield, water quality, and flood potential. Analysis of precipitation patterns, infiltration rates, erosion forces, and sediment carrying capacities of streams. Techniques and research methods used to control the hydrologic cycle, water quality, and water yield on wild lands. 3 units. *Hellmers*

217. Environmental Instrumentation. Theory and application of the physical bases for measuring parameters of natural and controlled environments. Properties and effective utilization of contemporary electronic measurement and data acquisition systems. Methods for obtaining and processing computer compatible experimental records. Three lectures and three laboratory hours per week. Prerequisite: consent of instructor. Students should have a basic knowledge of the properties of environmental parameters and be able to write computer programs. (Also listed as Botany 217L.) 4 units. *Knoerr*

218. Barrier Island Ecology. Adaptation of plants to barrier island migration and other physical characteristics of the coastal environment. Major emphasis will be placed on management of barrier beaches from Maine to Texas and the impact of human interference with natural processes. Field studies. Prerequisite: course in general ecology. (Given at Beaufort.) (Also listed as Botany 218 and under Marine Sciences.) 6 units. *Godfrey*

222. Biology of Forest Insects and Diseases. Fundamentals of entomology and plant pathology as applied to forest protection; coordinated laboratory work with emphasis on identification and interpretation of forest and wood degradation. 4 units. *Anderson and Stambaugh*

223. Forest Pathology. Diseases of North American forests and their timbers, with emphasis on current literature and control strategies. Field and laboratory diagnosis. Prerequisite: Forestry 222 or consent of instructor. 3 units; 4-5 units with laboratory modules. *Stambaugh*

225. Chemical Aspects of Forest Protection. Chemical aspects of organisms attacking trees and of materials used in their control. Emphasis on structures and properties in relation to functions and uses. Prerequisite: FES 222. 3 units. *Barnes*

230. Forest Entomology. Identification, biology, and control of insects that cause damage to trees and wood products. Emphasis of diagnosis is on the characteristics of the damage and the stages of the insects responsible. Prerequisite: FES 222 or equivalent, or consent of instructor. 4 units. *Anderson*

264. Soil Classification and Interpretation. Soil characteristics and environmental factors related to soil formation and soil classification systems. Interpretation of soil properties and soil maps for determination of forest, rural, and urban fringe use capabilities and limitations. Effects of forest management practices on soil productivity. Laboratory includes field identification of soils and measurements of soil properties. 4 units. *Ralston*

292. Microtechnique of Soft Woody Plant Tissues. Preparation of plant parts for microscopic study including sectioning, staining, and mounting techniques. Prerequisite: consent of instructor. Offered on sufficient demand. 3 units. *Philpott*

305. Forest Biochemistry. Biochemistry applied to structure and function of woody plants and associated fungi and insects. Prerequisites: courses in plant physiology and chemistry. 3 units. *Barnes*

321. Phytopathological Technique in Forestry. Fundamentals of phytopathology as applied to field and laboratory investigations of tree diseases and wood degradation; biological interpretation of host-pathogen-environment interaction is stressed in literature review, experimentation, and scientific writing. Prerequisite: consent of instructor. 4 units. *Stambaugh*

322. Microbiology of Forest Soils. Ecology of the microbial populations of forest soils, with emphasis on rhizosphere interactions, root pathogenesis, and mycorrhizae. Prerequisite: consent of instructor; mycology and bacteriology are recommended. 4 units. *Staff*

332. Ecology of Forest Insects. The influence of environmental factors on the vital processes of insects with emphasis on how both the abiotic and biotic elements influence the fluctuation of forest insect populations. Prerequisite: one course in entomology or zoology, or consent of instructor. 3 units, or 4 units with laboratory. *Anderson*

342. Hydrologic Processes. Physical processes of the hydrologic cycle with emphasis on those processes which can be modified or controlled by watershed management. Offered on sufficient demand. 3 units. *Knoerr*

350. Vegetation Productivity and Mineral Cycling in the Ecosystem. An ecosystem approach to studying the processes affecting productivity and mineral cycling in the world's biome. Emphasis on primary production, biomass accumulation, and biogeochemical cycling as affected by edaphic and climatic conditions. Concepts of ecosystem analysis and research methodology are stressed. Prerequisite: consent of instructor; FES 252, 264, and a course in plant physiology are recommended. 3 units. *Richardson*

366. Soil Fertility and Forest Production. Relationships of soil fertility factors to the growth of forest stands. Soil chemical properties and biological processes affecting mineral nutrition of trees. Soil amendment practices, including forest fertilization and land disposal of municipal wastes. Laboratory analysis of chemical composition of soil, water, and plant tissue samples. Prerequisite: FES 264. 4 units. *Ralston*

MEASUREMENTS, STATISTICS, AND MODELING

250. Biometry. Concepts and methods of statistics essential to the collection, analysis, and interpretation of resource and biological data. Emphasis is placed on problems of estimation, inference, and decision-making with experimental data. 3 units. *Yandle*

251. Theory and Methods for Sampling Biological Populations. Introductions to statistical methods for sampling natural resources and biological populations. Simultaneous consideration is given to theoretical and experimental problems in the design and applications of sampling methods and in the interpretation of sample data. Prerequisite: FES 250 or consent of instructor. 3 units. *Yandle*

252. Natural Resource Data Analysis. Emphasis on problem analysis based on a working knowledge of statistical methods and the calculus. Review of elementary concepts from statistics including measures of central tendency, measures of dispersion, probability distributions, and common tests of statistical inference. Rules and applications of matrix algebra and the calculus to biological

and natural resource problems. Major emphasis on concepts of data analysis, fitting and manipulation of functions using the calculus. 4 units. *Jayne*

253. Information Processing for Resource Management. Organization of information storage and retrieval systems. Extensive use of Fortran (WATFIV) programming and a statistical package (SAS) in resource and environmental problem solving. 3 units. *Rajagopal*

258. Quantitative Analysis in Resource Management. Mathematical model formulation and analysis in resource and environmental decision making. Includes a survey of applications of linear programming, dynamic programming, CPM-PERT, inventory, statistical quality control and simulation. Use of software codes in problem solving. 4 units. *Rajagopal*

354. Biological and Resource System Simulation. Introduction to systems terminology. Differential and difference equations. Probabilistic concepts. Time and event simulations using problem oriented software such as CMSP, DYNAMO, and GPSS. Applications in biological and resource sciences. Prerequisites: FES 252 or consent of instructor. 3 units. *Rajagopal*

NATURAL RESOURCE MANAGEMENT

282. Natural Resource Management. Methodologies for analysis of problems in resource management and their application to several specific problems. Techniques of simulation modeling will be used to integrate knowledge, define problem focus, and facilitate communication across ecological, economic, demographic, social, and political dimensions. 3 units. *Thompson*

349. Wildland and Wildlife Management. The paradox of managed natural systems is considered in the context of plant, animal, and human population dynamics. Topics include vegetation management, wildlife management, and wilderness recreation management, including camping, backpacking, hunting, and fishing. Special attention is paid to wildland preserve and open space planning. 3 units. *Staff*

NATURAL RESOURCE POLICY

269. Resource Economics and Policy. The application of economic concepts to private and public sector decision making concerning natural resources, especially renewable resources. Investment analysis, benefit-cost analysis. Planning and policy concepts. 3 units. *Convery*

270. Economics of Forestry. Economic concepts applied to private and public sector decision making concerning forest-based resources. The role of economics in public forest land-use planning. Benefit-cost analysis. Investment analysis and private forest lands. Offered alternate years. 3 units. *Convery*

273. Economics and Environmental Quality. Consideration of the economic dimensions of the environmental problem. Exploration of the reasons for market failure; investigation of possible remedies, including a tax on residuals and direct control. Examination of the modifications required in cost-benefit and input-output analysis to incorporate environmental values. Discussion of economic growth, natural resource scarcity, and environmental quality. Prerequisite: consent of instructor. 3 units. *Convery*

SEMINARS

277. Seminar in Natural Resource Allocation and Efficiency. Evaluation of economic principles concerned with problems of natural resource allocation, with

special attention to the alternatives for governmental policies in private property economics. Prerequisite: consent of instructor. Offered alternate years. 1 unit.
Convery

344. Micrometeorology and Biometeorology Seminar. Advanced topics in the physics of the surface environment of the earth, with emphasis on plant and animal microclimates; budgets of mass, momentum, and energy; vertical structure of wind, temperature, water vapor, and carbon dioxide in relation to exchange processes within the biosphere. Prerequisites: FES 204 or equivalent and consent of instructor. Offered on sufficient demand. 2 units. *Knoerr*

346. Seminar in Resource and Environmental Policy. Discussion of the political, legal, and socioeconomic aspects of public and private action in environmental quality control and management. Prerequisites: FES 269 or consent of instructor. 1 unit. *Convery*

347. Seminar in Natural Resource Ecology. Discussion of current ecological and environmental problems and research topics related to the management of natural resources. Credit to be arranged. *Staff*

348. Integrated Case Studies in Natural Resource Analysis Seminar. Examination and analysis of the integrated case study for solving resource and environmental problems. Credit to be arranged. *Staff*

385. Seminar in Forest Protection. Current problems in forest and shade tree protection and research applications in entomology, pathology, and physiology as related to natural resource management. Prerequisite: consent of instructor. 1 unit.
Staff

386. Seminar in Forest Management. Examination and analysis of techniques employed in the management of industrial and public forests, particularly in the South. Discussion of problems of large scale intensive forest management. Prerequisites: FES 244 and 281 or equivalents. 1 unit. *Staff*

SPECIAL STUDIES AND PROJECTS

201. Field Studies. Visits to and studies of resource use and management areas and activities outside the University. Credit to be arranged. *Staff*

202. Student Projects. A group of five or more students may plan and conduct their own research project on a special topic, not normally covered by courses or seminars. A request to establish such a project should be addressed to the Dean with an outline of the objectives and methods of study and a plan for presentation of the results to the school. The Dean will designate the units to be earned and a faculty member for the evaluation and grading of the work of each participant.

299. Independent Projects. Directed readings, research, or practical work at the graduate level to meet the needs of individual students in the following areas. Credit to be arranged. Undertaken with the guidance of the faculty member listed.

- 299.1 Dendrology. *Staff*
- 299.2 Ecology. *Richardson, Thompson*
- 299.3 Entomology. *Anderson*
- 299.4 Environmental Design. *Staff*
- 299.5 Environmental Education. *Rajagopal*
- 299.6 Environmental Policy and Values. *Convery*
- 299.7 Environmental Systems Analysis. *Staff*
- 299.8 Forest Management. *Staff*
- 299.9 Mensuration and Biometry. *Yandle*
- 299.10 Meteorology and Hydrology. *Knoerr*
- 299.11 Operations Research. *Rajagopal*

- 299.12 Pathology. *Stambaugh*
- 299.13 Physiology and Biochemistry. *Barnes, Hellmers*
- 299.14 Plant Anatomy. *Philpott*
- 299.15 Propagation of Woody Plants. *Philpott*
- 299.16 Resource Economics. *Convery*
- 299.17 Resource Planning. *Staff*
- 299.18 Resource Management. *Staff*
- 299.19 Silviculture. *Staff*
- 299.20 Soils. *Ralston*

The University Program in Genetics

Professor Guild, *Director* (biochemistry); Professors Amos (microbiology and immunology), Antonovics (botany), Boynton (botany), Burns (microbiology), Gillham (zoology), Gross (biochemistry), C. Ward (zoology), and Webster (biochemistry); Associate Professors Counce (anatomy), Greene (biochemistry), and F. Ward (microbiology and immunology); Assistant Professors Endow (microbiology), Greenleaf (biochemistry), V. Hershfield (microbiology), M. Hershfield (biochemistry and medicine), Holmes (biochemistry and medicine), Kredich (biochemistry and medicine), Modrich (biochemistry), Schachat (anatomy), Steege (biochemistry)

The University Program in Genetics provides a coherent course of study in all facets of biology related to genetics. Graduate students registered in any of the biological sciences departments may apply to the faculty of the genetics program to pursue study and research leading to an advanced degree. It would be helpful if applicants for admission to the Graduate School indicated their interest in the genetics program at the time of application. Requests for information describing more completely the research interests of the staff, facilities, and special stipends and fellowships should be addressed to the Director, Genetics Program (151 Nanaline H. Duke).

For Seniors and Graduates

216. Molecular Genetics. Genetic mechanisms and their relationship to nucleic acids and their synthesis. Prerequisites: introductory courses in biochemistry and genetics, or consent of instructor. (Also listed as Biochemistry 216.) 4 units. *Guild and staff*

280. Principles of Genetics. Structure and properties of genes and chromosomes in individual organisms and in populations. Prerequisites: introductory biology, Chemistry 12, and Mathematics 31, or equivalents. (Also listed as Botany 180, Botany 280, Zoology 180, and Zoology 280.) 3 units. *Antonovics, Boynton, and Gillham*

282. Experimental Genetics. Laboratory exercises and discussions on the molecular mechanisms of mutation, recombination, replication, transcription, and translation of the genetic material. May be taken concurrently with Genetics 280. Prerequisite: consent of instructor. (Also listed as Biochemistry 282.) 2 units. *Modrich and Staff*

283. Extrachromosomal Inheritance. Genetics, biochemistry and molecular biology of the organelles of eukaryotic cells, bacterial plasmids and episomes, and cellular symbionts. Emphasis on recent literature. Prerequisite: introductory genetics. (Also listed as Zoology 283 and Botany 283). 3 units. *Boynton and Gillham*.

284. Current Topics in Genetic Mechanisms. A seminar and lecture course devoted to the analysis of the current literature in molecular genetics. Given in

response to adequate demand. Prerequisites: Genetics 280 or equivalent, and consent of instructor. (Also listed as Biochemistry 284.) 1 unit. *Staff*

285. Ecological Genetics. Interaction of genetics and ecology and its importance in explaining the evolution, diversity, and distribution of plants and animals. Prerequisites: Botany 280 and 286 or their equivalents. (Also listed as Botany 285S.) 3 units. *Antonovics*

286. Evolutionary Mechanisms. Population ecology and population genetics of plants and animals. Fitness concepts, life history evolution, mating systems, genetic divergence and causes and maintenance of genetic diversity. Complements Zoology 235. Prerequisite: college biology and Genetics 280, or equivalent. (Also listed as Botany 286, and Zoology 286.) 3 units. *Antonovics and H. Wilbur*

287S. Quantitative Genetics. Analysis of genetic variation in continuous traits. Models of continuous variation; genetic, environmental and interaction components; genetic correlation; heritability estimation; selection response. Prerequisites: Botany 180 or Botany 280, or equivalent, and consent of instructor. (Also listed as Botany 287S.) 3 units. *Antonovics*

288S. The Cell in Development and Heredity. A seminar on topics of current interest and controversy. Prerequisites: a course in genetics and consent of instructor. (Also listed as Anatomy 288S and Zoology 288S.) 2 units. *Counce*

289. Problems in Genetics in Current Research. Prerequisites: introductory genetics and consent of instructor. 3 units. *Gillham*

For Graduates

336. Immunogenetics. Antigens of tissues and organs, distribution, extraction, and chemistry. Phylogeny of iso-antigenic systems of man and animals. Tests for histocompatibility including lymphocyte interactions and reactivity. Change in antigenicity and immune responsiveness in carcinogenesis. Immunologic factors in pregnancy and in homotransplantation of organs. (Also listed as Microbiology and Immunology 336.) 2 units. *Amos and Ward*

351-352. Genetics Seminar. Required of all students specializing in genetics. (Also listed as Biochemistry 351-352.) 1 unit each semester. *Gross and staff*

Geology

Professor Perkins, *Chairman* (119 Science); Professor Heron, *Director of Graduate Studies* (114 Science); Professor Pilkey; Associate Professors Furbish and Lynts; Assistant Professor Rosendahl

The Department of Geology offers graduate work leading to the M.S. and Ph.D. degrees. An undergraduate degree in geology is not a prerequisite for graduate studies, but a student must have had or must take a summer field geology course (or equivalent experience), mineralogy, petrology, stratigraphy, paleontology, and structural geology. In addition, the student must have had one year of college chemistry, one year of college physics, and mathematics through calculus.

Graduate courses in the Department of Geology are designed to provide specialized training in the fields of geological oceanography, sedimentology, stratigraphy, paleontology, geophysics, and low-temperature mineralogy.

An acceptable thesis is required. There is no language requirement for the M.S. degree.

The Ph.D. degree is available through the Earth Science Consortium, a new interuniversity doctoral program combining the faculties and research facilities of Duke, Emory, Tulane, and Vanderbilt Universities. The Earth Science Consortium

offers specialization in the areas of paleontology, sedimentology, stratigraphy, marine geology and geophysics, environmental geology, and regional geology. Under this program, a student admitted to Duke University would be expected to spend one year of study at another of the participating universities. Such a program offers the student a broadly-based faculty with diverse research interests and the opportunity to pursue graduate education in a variety of geologic settings. Normally, a candidate would hold the master's degree at the time of admission to the program. Additional information concerning the details of the doctoral program is available upon request.

For Seniors and Graduates

205. Geological Oceanography. Broad geologic aspects of the ocean basins, including origin, bottom physiology, sediment distribution, and sedimentary processes. Field observations; sampling procedures. Not open to students who have completed Geology 206S. (Given at Beaufort.) (Also listed under Marine Sciences.) 6 units. *Glaser and Pilkey*

206S. Principles of Geological Oceanography. A survey of geological aspects of the oceans including sediment types, processes of sedimentation, geologic structures of the ocean basins, and bottom physiography. Prerequisite: Geology 108 or consent of instructor. 3 units. *Pilkey*

211S. Stratigraphic Principles and Application. Prerequisite: Geology 108. 3 units. *Perkins*

212. Carbonate Facies Analysis: Recent and Ancient. Origin, distribution, and diagenetic alteration of recent carbonate sediments and their ancient analogs. Prerequisite: Geology 211S. Offered biennially. 3 units. *Perkins*

213. Sedimentology. Parameters of sedimentation, sediment classification, and laboratory methods of analysis. Lectures and laboratory. Offered biennially. 3 units. *Pilkey*

214S. Sedimentary Petrography. Descriptive and interpretive analysis of sediments and sedimentary rocks in thin section, with an emphasis on diagenesis. Prerequisite: consent of instructor. 3 units. *Perkins*

215. Clastics Facies Analysis: Recent and Ancient. Origin, distribution, and diagenetic alteration of recent and ancient clastic sequences. Prerequisite: Geology 211S. Offered biennially. 3 units. *Heron*

229. Economic Geology. Principles and processes involved when elements are concentrated to economic proportions in magmatic, metamorphic, hydrothermal, sedimentary, or surface environments. Prerequisite: Geology 102. Offered biennially. 3 units. *Furbish*

230. Principles of Structural Geology. Description, origin, and interpretation of primary and secondary geologic rock structures. Prerequisites: Geology 106 and 108. 3 units. *Rosendahl*

234S. Geochemistry. Concentration on magmatic and thermal processes. Prerequisites: Geology 106 and Physics 52, or consent of instructor. 3 units. *Rosendahl*

235S. Global Tectonics. Sea-floor spreading, geometry of plate tectonics, and relationship of plate tectonics to geology. Prerequisites: Geology 230 and 251. Offered biennially. 3 units. *Lynts and Rosendahl*

241. Invertebrate Paleobiology I. Basic concepts of taxonomy and evolution; biologic and stratigraphic relationships of lower invertebrates and their phylogeny.

Lectures and laboratory. Prerequisites: Geology 72 or consent of instructor. Offered biennially. 3 units. *Lynts*

242. Invertebrate Paleobiology II. Biologic and stratigraphic relationships of higher invertebrates and their phylogeny. Lectures and laboratory. Prerequisites: Geology 241. Offered biennially. 3 units. *Lynts*

243-244. Micropaleontology. Microscopic animal and plant fossils, exclusive of spores and pollen, with special emphasis on their biology, taxonomy, evolution, and stratigraphic distribution. Lectures and laboratory. Prerequisites: Geology 241 and 242, or consent of instructor. Given biennially. 6 units. *Lynts*

247. Paleoecology. Application of ecologic and geologic principles to the reconstruction of the interrelationship between organisms and their environment in geologic time. Prerequisites: Geology 108 and 242, or consent of instructor. Given biennially. 3 units. *Lynts*

250. Introduction to Marine Geophysics. Topics include seismic reflection and refraction, magnetics, gravity, and seismology. Prerequisite: introductory physics or consent of instructor. (Given at Beaufort.) (Also listed under Marine Sciences.) 6 units. *Rosendahl*

251. Principles of Geophysics. Theory, techniques, and interpretation. Aspects of seismology, geomagnetism, gravity, and heat flow. Prerequisites: Physics 52, Mathematics 32, Geology 1, or consent of instructor. 3 units. *Rosendahl*

252. Marine Geophysics. Survey of methods in the study of the oceanic crust and mantle. Prerequisite: Geology 251 or consent of instructor. Given biennially. 3 units. *Rosendahl*

253S. Seminar in Geophysics. Principal geophysical techniques and their application to problems in earth science. Prerequisite: Geology 251, or concurrent enrollment and consent of instructor. Offered biennially. 3 units. *Rosendahl*

260S. Hydrocarbon Exploration. Origin, migration, and accumulation of hydrocarbons with emphasis on exploration techniques. Prerequisites: Geology 211S and 251. Offered biennially. 3 units. *Perkins and Rosendahl*

For Graduates

300. Seminar in Oceanography.* 1 to 3 units. *Staff*

310. Seminar in Stratigraphy.* 1 to 3 units. *Staff*

312. Seminar in Sedimentology.* 1 to 3 units. *Staff*

320. Seminar in Mineralogy.* 1 to 3 units. *Staff*

330. Seminar in Geochemistry.* 1 to 3 units. *Staff*

340. Seminar in Paleontology.* 1 to 3 units. *Staff*

350. Seminar in Geomathematics.* 1 to 3 units. *Staff*

360. Seminar in Geophysics.* 1 to 3 units. *Staff*

371, 372. Advanced Topics in Geology.* To meet the individual needs of graduate students for independent study in various environmental sedimentary fields. 1 to 3 units. *Staff*

*Offered on demand.

Germanic Languages and Literature

Professor Phelps, *Chairman* (106 Languages); Associate Professor Rolleston, *Director of Graduate Studies*; Professor Jantz; Associate Professors Alt and Borchardt; Assistant Professor Rosenberg

The Department of Germanic Languages and Literature offers graduate work leading to the A.M. degree. Students who expect to major in German should have had sufficient undergraduate courses in Germanic languages to enable them to proceed to more advanced work.

Students who wish to take courses in German as a related field should normally have completed a third-year course (in exceptional cases, a second year) of college German with acceptable grades.

For Seniors and Graduates

200. Proseminar. Fundamental course for advanced study of German; literary history, schools of criticism, practical exercises in interpretation, and research methods. 3 units. *Borchardt or Alt*

201S, 202S. Goethe. His life and works, in the light of his lasting significance to Germany and world literature. First semester: lyrics, prose, fiction, and selected dramas; second semester: *Faust I and II*. 3 units each semester. *Jantz or Phelps*

203S. Eighteenth Century. Eighteenth-century German literature in its relation to European intellectual currents of that time. 3 units. *Phelps*

205, 206. Middle High German. The language and literature of Germany's first classical period. (Also listed under Medieval and Renaissance Studies.) 3 units each semester. *Rosenberg*

207S. German Romanticism. The principal writers of the period from 1795 to 1830. 3 units. *Rolleston or Alt*

209S. Drama. Studies in the German-speaking theater with emphasis on the nineteenth century. 3 units. *Alt*

211S. Nineteenth-Century Literature. From the end of Romanticism through Realism. 3 units. *Alt*

214S. The Twentieth Century. Literature of the twentieth century presented through representative authors. 3 units. *Rolleston*

215S. Seventeenth-Century Literature. Leading writers of the Baroque, viewed against the background of their time. (Also listed under Medieval and Renaissance Studies.) 3 units. *Borchardt*

216. History of the German Language. Development of the phonology, morphology, and syntax of German from the beginnings to the present. (Also listed under Medieval and Renaissance Studies.) 3 units. *Rosenberg*

217S. Renaissance and Reformation Literature. The period from 1400 to about 1600. (Also listed under Medieval and Renaissance Studies.) 3 units. *Borchardt*

218S. The Teaching of German. A survey of modern teaching techniques: problems in the teaching of German on the secondary and college levels. Analysis and evaluation of textbooks and related audiovisual materials. 3 units. *Phelps*

219. Applied Linguistics. The application of modern linguistic principles to a systematic study of the phonetics, morphology, and syntax of modern German. Prerequisite: consent of instructor. 3 units. *Rosenberg*

230. Lyric Poetry. Studies in poetry and poetic theory. From Goethe and the Romantics to Rilke, Benn, and contemporary authors. 3 units. *Rolleston*

For Graduates

301. Gothic.* 3 units. *Rosenberg*

321, 322. Germanic Seminar. 3 units each semester. *Alt, Borchardt, Phelps, or Rolleston*

Health Administration

Professor Jaeger, *Chairman* (156A Trent Drive Hall); Assistant Professor Smith, *Director of Graduate Studies* (156D Trent Drive Hall); Professors Brown and Warren; Adjunct Professor Kaluzny; Associate Professors McCool, Minniear, and Swanson; Adjunct Associate Professors Coulter and Peck; Assistant Professors Delaney, Falcone, and Warner; Lecturers Henderson-James, and Winfree; Research Associate Cusic

Graduate study leading toward preparation for a career in the administration of all types of health organizations and programs is offered through a twenty-month academic program that leads to the M.H.A. degree. Students without previous administrative experience in the health field are urged to undertake a twelve-month administrative residency following graduation. This residency is a period of varied administrative experience that is conducted under faculty supervision and is individually designed around each student's interests. For students without previous administrative experience, the residency should be considered an integral part of the M.H.A. program. Admission to this program is based upon suitability of the candidate to assume leadership roles in the organization and management of the delivery of health services, as well as on capability for graduate study.

300. Introduction to Medical Care. An introduction to the major medical topics associated with health and illness. 2 units. *Staff*

301. The Health System and Its Environment. An introduction to the organization and management of health services from a systems perspective. Emphasis is on the components of the present system and on the interplay of forces within the system and between the system and its environment. 4 units. *Jaeger*

312. Comparative Health Systems. A comparative examination of the structure and performance of the health systems of the United States and other countries, particularly Canada and Great Britain. Topics include current financing, capitalization, utilization, control, and the relative roles of the governmental and private sectors. 2 units. *Falcone*

313. Quantitative Decision Making. The development of a quantitative modeling framework derived from the concepts of the systems approach to analyze management decisions in health administration. The focus of the course is on the knowledge and skills needed to manage the analysis (i.e., formulation, assumptions, interpretation, cost of analysis) rather than on performing the analysis, emphasizing the process of analysis over detail of techniques. Decisions are analyzed both deterministically and stochastically, and on a scale from simple to complex. Techniques that serve the framework include calculus, inventory theory, PERT, decision analysis, fixed vs. variable cost analysis, queueing, simulation, and

*Offered on demand.

mathematical programming. Examples from the field are used extensively. The latter part of the course presents the concepts of quantitative control, with the same emphasis and again with examples from the field. 4 units. *Warner*

320. Principles of Economics. A selective introduction to the field of economics designed to provide the student with a knowledge of how economic forces affect managerial decisions. 2 units. *Staff*

326. Health Economics. A study of the current state of knowledge with regard to the economics of health and medical care. Attention is given to the unique problems of demand and supply in the health services sector, as well as the implications of private and public financing alternatives; restrictions on manpower entry; incentives and mobility; and problems of productivity measurement and changes. 2 units. *Staff*

331, 332. Planning Health Services. This course sequence addresses the planning for the delivery of health services, both at the systems level (area; community) and at the organizational level (institutions; program). Emphasis is on analytic techniques, measurement and evaluation, and the dynamics of the planning process. The courses include use of case studies and simulations. 4 units each semester. *Smith and Swanson*

333. Health Finance. Application of the principles of financial and managerial accounting to the health environment. Discussion of influences of reimbursement, mechanisms of rate setting, applications of budgeting principles and working capital management. 4 units. *Delaney*

335. Ambulatory Health Services. This course covers the noninstitutional components of the organization and provision of personal health services. The principal emphasis is on medical group management, including forms of organization, financing of services, physician-patient relationships, medical records, and peer review. Other topics include dental care, home care, halfway houses, multiphasic screening, and community health and mental health centers. 3 units. *Staff*

340. Social Dimensions of Illness. Introduction to basic principles of epidemiology, discussion of major health problems as they affect individuals, families, populations, and the health system, and consideration of the applications of epidemiological concepts to the evaluation and planning of health organizations and systems. 3 units. *Smith*

343. Human Resource Development in Health Institutions. Application of learning and systems theory to the development of human resources within health institutions. Examination of the concept of human resource development, the institutional training system, and the use of the educational process to facilitate the development of the work force is stressed. 3 units. *McCool*

344. Human Resource Management in Health Institutions. Application of social systems theory to the management of human resources within health institutions. Detailed examination of the environment, structure, process, and output of human resource management is stressed. 4 units. *McCool*

345. Public Policy and Health Care. A study of the development and present status of selected public policy issues within their social, economic, and political contexts. Alternative courses of possible public action are reviewed and their probable outcomes are assessed. 4 units. *Falcone*

346. Community Health Services. The focus of this course is the organization and management of health services directed toward general populations rather

than individuals. Coverage includes aspects of environmental and occupational hygiene, nutrition and housing, planning community health services, preventive health education and programs, and other public health activities. Included are the problems associated with health status measurements and assessment. 3 units. *Staff*

348. Legal Considerations in Health Administration. Introduction to law and the legal process as it relates to health administration, emphasizing the contribution that law makes to ethical and effective management practices. Topics include the constitutional basis for government support of health care services, constraints that law and regulations impose on the health care industry, public accountability, liability of health care providers, rights of patients, and administrative and business law for health care organizations. Students will prepare legal-type memoranda and participate in a mock trial or a demonstration of an administrative hearing. 4 units. *Warren*

351. Institutional Health Services. A broad examination of the provision of health services in institutional settings. The principal focus is on the general hospital, but attention is also given to the mental hospital and other long-term care institutions. Specific study utilizing lectures and cases is made of the administrative and informational organization; the structure and function of each department; relationships between administration and the governing board, the medical staff, and the community; operational and capital financing; the planning function; and the evaluation of performance. 3 units. *Staff*

352. Ambulatory Health Services. This course covers the components of the organization and provision of personal health services in the ambulatory setting. Emphasis is on medical group management, including forms of organization, financing of services, physician-patient relationships, medical records, and peer review. 3 units. *Staff*

353. Community Health Services. The focus of this course is the organization and management of health services directed toward general populations rather than individuals. Topics include aspects of environmental and occupational hygiene, nutrition and housing, planning community health services, preventive health education and programs, other public health activities, and problems associated with health status measurement and assessment. 3 units. *Staff*

360. Seminar in Health Administration. Analysis of strategic policy options for health care institutions drawing extensively from emerging multiunit health systems. Focus upon environmental interaction with existing hospital and health service organizations and the strategic policy choices being made to adapt to change. 3 units. *Brown*

361, 362. Case Studies in Health Administration. An integrating course sequence consisting of analyses of cases taken from institutional and programmatic health service settings. 3 units each semester. *Staff*

363. Health Administration Game. Designed around a sophisticated computer game, this course examines administrative planning and decision making in a simulated market for health services where part of the market is competitive and part is cooperative. Students assume roles as hospital administrators, health planning agency decision makers, and third party players. The game translates decisions from these players into simulated results, and prepares reports from which future decisions can be made. 3 units. *Warner*

371, 372. Directed Research. Individual studies by arrangement. 3 units each semester. *Staff*

373. Current Legal Problems in Health Administration. This course follows up Health Administration 348 by providing an examination of selected current problems in health administration which are substantially affected by law and regulations. It is designed to acquaint students with the identification of legal problems in practical situations and to recognize legal alternatives. Topics may include union activities, relations with the media, liability coverage mechanisms, governing board and medical staff responsibilities, professional and vendor contracts, tax problems and disputes between providers and government agencies, emphasizing the proper roles of attorney and administrator in each situation. Students will prepare legal-style memoranda and present "briefings" on the legal aspects of chosen topics. 3 units. *Warren*

377. Research Design and Data Analysis. Covers multivariate techniques, scaling, factor analysis, and causal modeling. Assumes Management Science 311 or equivalent, although some intermediate statistics will be reviewed. 3 units. *Falcone*

381. Strategy and Organizational Design for Health Systems. This course stresses strategic policy choices, assessment, and processes and the design of change processes and organizations to accomplish the policy choice. Examples are drawn primarily from innovative multiple unit health care delivery systems. Students are encouraged to develop and test creative system strategies. 3 units. *Brown*

387. Information Systems. Technical and functional aspects of computerized hospital information systems from a management perspective, with emphasis on fundamentals of hardware and software, applications and system alternatives. 3 units. *Staff*

Management Sciences Courses for Students in Health Administration

300. Managerial Economics. Introduction to the economic theory of organizations and models for resource allocation in an organization. Also provides an understanding of how alternative market structures affect resource allocation decisions made by organizations. 4 units. *Staff*

310. Quantitative Methods. Mathematics for optimization with and without constraints in linear and nonlinear systems, and an introduction to probability theory. Topics related to optimization include partial derivatives, Lagrange multipliers, Kuhn-Tucker conditions, and linear programming. Those related to probability theory include sample spaces, events probability axioms, random variables, distributions, the Chebychev inequality and the Central Limit Theorem. 4 units. *Staff*

311. Statistical Analysis for Management Decisions. Concepts and models of probability and techniques of classical statistics: sampling, estimation, hypothesis testing, and regression. 4 units. *Staff*

320. Organization Analysis and Design. A macroscopic study of organizations as socioeconomic-political systems for collective action embedded in an uncontrollable environment. Specific topics include: (1) alternative theories of organization, with particular emphasis on modern systems, and cybernetic approaches and (2) introduction to organization design with particular emphasis on goal formation, performance measurement, decomposition, administrative mechanisms for coordination and control, and organization change and adaptation. 4 units. *Staff*

330. Financial Accounting. Information requirements imposed on the organization by agencies in its environment; activities of the firm within the framework

of a financial accounting system designed to satisfy these information requirements. Emphasis is given to the study of financial accounting reporting and measurement problems from a theoretical and an applied basis, using cases and topical problems in financial accounting as a foundation for the learning experience. 4 units. *Staff*

331. Managerial Accounting. Establishes the relationships between the strategies of the organization as reflected in its planning activities and the impact of those plans on the data gathering, reporting activities, and operations inside the organization. Specific topics include budgeting, standard costing, control in a programmed environment, capital budgeting, and funds analysis. 4 units. *Staff*

333. Controllership. The need for control and effective ways to provide it, primarily through budgetary processes. Special attention is devoted to project evaluation, control reports, and analysis of the variance between planned results and actual results. 4 units. *Staff*

344. Human Resources Management. An application of behavioral and economic theories and of quantitative techniques to management of the firm's human resources, including treatment of both labor and management personnel. Detailed examination of American occupational structure (e.g., mobility patterns, increasing specialization, and professionalization) and analysis of the labor union as an institution are included. Topics studied within the constraints of industrial, educational, and labor institutional structure are: employee testing, selection and assignment, training and development, performance evaluation and optional incentive systems, strategic and tactical factors in collective bargaining. 4 units. *Staff*

351. Financial Management. Sources and uses of financial resources for the organization are examined. Capital budgeting, cash management, and the mix of external financing are examined in the context of attempts to achieve the optimal capital structure of the organization. 4 units. *Staff*

History

Professor Durden, *Chairman* (235 Allen); Professor Richards, *Director of Graduate Studies* (237 Allen); Professors Colton, Davis, Ferguson, Holley, Hollyday, Lerner, Oates, Preston, Ropp, A. Scott, W. Scott, TePaske, Watson, and Young; Associate Professors Bergquist, Cell, Chafe, Crellin, Decker, Dirlik, Gavins, Gifford, Goodwyn, Hartwig, Maier, Mauskopf, Miller, Nathans, Richards, Witt, and Wood; Assistant Professors di Corcia, Huber, and Kuniholm; Visiting Assistant Professor Reddy

The Department of History offers graduate work leading to the A.M. and Ph.D. degrees. Candidates for the A.M. degree must have a reading knowledge of at least one ancient or modern foreign language related to their programs of study and have completed successfully a substantial research paper, normally the product of a year's seminar or two semester-courses. The paper must be approved by two readers—the supervising professor and a second professor from the graduate staff. Students anticipating a May degree must have their papers read and approved by 15 April; those anticipating a September degree must have their papers read and approved by 15 August.

Candidates for the degree of Doctor of Philosophy are required to prepare themselves for examinations in four fields. Three usually shall be history. The choice of fields is determined in consultation with the student's supervisor and the Director of Graduate Studies. The department offers graduate instruction in the fields of Africa, Afro-American history, ancient history, medieval and early

modern Europe, modern Europe, American history, Britain and the Commonwealth, Imperial Russia, Soviet Russia, Latin America, South Asia, modern China, modern Japan, military history, history of science, and history of medicine. The candidate for the Ph.D. degree usually must have a reading knowledge of two foreign languages, but in certain cases where the candidate's supervisor and the Director of Graduate Studies approve, and where the candidate's research for the dissertation would appreciably benefit, an alternative to the second language may be accepted. This alternative usually would take the form of successfully completed formal training in an auxiliary discipline (such as statistics or a course in one of the other social sciences with an emphasis upon methodology) of 3 to 6 units, or the equivalent, depending on the student's program. It also must be in addition to any previous undergraduate work in the discipline. The requirement, whether satisfied by two languages or by one language and an alternative, must be met prior to the preliminary examination.

Ancient History. For courses in ancient history which may be taken for credit in either history or classical studies, see Classical Studies.

For Seniors and Graduates

Students may receive credit for either semester of a hyphenated course at the 200-level without taking the other semester if they obtain written consent from the instructor.

201S, 202S. Aspects of Change in Prerevolutionary Russia. Origin and dynamics of the Russian revolutionary movement, the intelligentsia, and the emergence of the labor movement. 3 units each semester. *Miller*

203. The Uses of History in Public Policy: I. (Also listed as Public Policy Sciences 271.) 3 units. *Goodwyn*

204. The Uses of History in Public Policy: II. (Also listed as Public Policy Sciences 273S.) 3 units. *Kuniholm*

205S. Progressive Era in the United States and World War I. 3 units. *Watson*

206S. The Nineteen-Twenties and the New Deal in the United States. 3 units. *Watson*

207S, 208S. The Development of Urban America. The process of urbanization from rural society to the modern city. 3 units each semester. *Decker or A. Scott*

209S, 210S. Topics in Afro-American History, 1619-Present. Critical issues of the collective experience of Afro-Americans with special attention to Black institutional development. (Also listed as Afro-American Studies 209S, 210S.) 3 units each semester. *Gavins*

212. Recent Interpretations of United States History. A course designed to encourage a critical evaluation of important issues in United States history through examination of recent interpretations. This course meets for three-hour meetings twice each week and ends at mid-semester. 3 units. *Watson and staff*

213. Medicine and Society in America. Emergence of modern medical science, patterns and options for medical care, and health-related ethical issues considered in historical and contemporary American background. 3 units. *Gifford*

215-216. The Diplomatic History of the United States. (Not open to undergraduates who have had History 121-122.) 6 units. *Davis*

217S. Fascism and Its Background. Italy and Germany, with some attention to France and Eastern Europe. 3 units. *Maier*

218S. Twentieth-Century Europe: Social and Economic Issues. Inflation, mass unemployment, and the international economy. 3 units. *Maier*

219. Culture and Society in German Speaking Europe, 1870-1930. Relationship of German and Austrian literature, opera, and social thought to the political and economic transformations of the era. 3 units. *Maier*

221. Problems in the Economic and Social History of Europe, 1200-1700. (Also listed under Medieval and Renaissance Studies.) 3 units. *Witt*

222. Problems in European Intellectual History, 1250-1550. (Also listed under Medieval and Renaissance Studies.) 3 units. *Witt*

223S, 224S. The Old Regime, the Enlightenment, and the French Revolution. Political, social, and intellectual trends in seventeenth- and eighteenth-century Europe, with emphasis on France and the French Revolution. 3 units each semester. *di Corcia*

227-228. Recent United States History: Major Political and Social Movements. 6 units. *Chafe*

229. Recent Interpretations of Modern European History. A course designed to develop the ability to appraise critical historical issues through the study and discussion of recent interpretations of key historical problems in modern European history. (Open only to history graduate students and seniors doing practice teaching in one of their final two semesters.) 3 units. *Staff*

230. Recent Interpretations of Asian History. Critical study of historical literature pertaining to China, Japan, and India. 3 units. *Richards*

231S, 232S. Problems in the History of Spain and the Spanish Empire. 3 units each semester. *TePaske*

234S. Political Economy of Development: Theories of Change in the Third World. (Also listed as Anthropology 234S, Political Science 234S, and Sociology 234S.) 3 units. *Bergquist, Pessar, Portes, Smith, and Valenzuela*

237S. Europe in the Early Middle Ages. (Also listed under Medieval and Renaissance Studies.) 3 units. *Young*

238S. Europe in the High Middle Ages. (Also listed under Medieval and Renaissance Studies.) 3 units. *Young*

240. Aspects of Traditional and Modern African Culture. Introduction to the oral and written literatures and musical and artistic traditions. 3 units. *Hartwig*

241-242. Modernization and Revolution in China. 6 units. *Dirlik*

243-244. Marxism and History. The first semester examines theoretical perspectives through the works of Marxist thinkers in relation to other important currents in history since the nineteenth century. The second semester considers applications that illustrate the contributions of Marxist historiography to specific areas of historical inquiry. 6 units. *Dirlik*

247. History of Modern India and Pakistan, 1707-1857. Analysis and interpretation, with special emphasis on social and economic change. 3 units. *Richards*

248. History of Modern India and Pakistan, 1857 to the Present. 3 units. *Richards*

249-250. Social and Intellectual History of the United States. The interplay of ideas and social practice through the examination of attitudes and institutions in such fields as science and technology, law, learning, and religion. 6 units. *Holley*

253S, 254S. Europe Between the Wars. First Semester: 1914-1933. Second Semester: 1933-1945. 3 units each semester. *W. Scott*

255S-256S. Problems in African History. 6 units. *Hartwig*

260. Economic History of Japan. (Also listed as Economics 232.) 3 units. *Bronfenbrenner*

261-262. Problems in Soviet History. Studies in the background of the Revolution of 1917 and the history and politics of the Soviet state. 6 units. *Lerner*

263-264. American Colonial History and the Revolution 1607-1789. The founding and institutional development of the English colonies; the background, progress, and results of the Revolution. 3 units each semester. *Wood*

265S, 266S. Problems in Modern Latin American History. 3 units each semester. *Bergquist*

267S-268S. From Medieval to Early Modern England. The intellectual, social, and political problems of transition to modern England, with special emphasis on the English Renaissance. (Also listed under Medieval and Renaissance Studies.) 6 units. *Ferguson*

269-270. British History, Seventeenth Century to the Present. Historiography of social structure and social change: English Revolution, party, the Industrial Revolution, class and class consciousness, Victorianism, and the impact of war in the twentieth century. 6 units. *Cell*

272. Poverty in the United States: An Historical Perspective. (Also listed as Public Policy Sciences 272.) 3 units. *Decker*

273, 274. Topics in the History of Science. Critical stages in the evolution of scientific thought. 3 units each semester. *Mauskopf*

275S, 276S. Central Europe, 1848-1918. Conflict between liberalism and authoritarianism, clash of nationalities, diplomatic interaction, emphasizing domestic changes in Germany and Austria-Hungary. 3 units each semester. *Hollyday*

277S. The Coming of the Civil War in the United States, 1820-1861. 3 units. *Durden*

278S. The Civil War in the United States and its Aftermath, 1861-1900. 3 units. *Durden*

280. Historiography. Great historians since Herodotus and an examination of recent twentieth-century trends. 3 units. *Hollyday*

282S. Seminar on Canada. Each year a different theme will be studied, e.g. nationalism in Canada, resources and environment, Canadian defense policies, Canadian-American relations, minorities in Canada, etc. (Also listed as Anthropology 282S, Economics 282S, Political Science 282S, and Sociology 282S.) 3 units. *Staff and visitors*

283. Political and Social Change in the United States, 1789-1860. 3 units. *Nathans*

285S, 286S. Oral History. Research on race relations and civil rights in the United States in the twentieth century using techniques of oral history. 3 units each semester. *Chafe and Goodwyn*

287-288. History of Modern Japan. The political, economic, and social development of Japan since 1750; factors contributing to Japan's emergence as a modern state. 6 units. *Staff*

297S. The British Empire of the Nineteenth Century. The development of the Empire from the American Revolution to the imperialism that culminated in the South African War. 3 units. *Preston*

298S. The Commonwealth in the Twentieth Century. The origins and evolution of the Commonwealth of Nations and its adjustment in the age of anticolonialism. 3 units. *Preston*

Seminars for Graduates

307-308. Seminar in United States History. 6 units. *American history staff*

317, 318. Seminar in the History of Western Europe. 3 units each semester. *Hollyday and W. Scott*

371-372. Research Seminars. To be taken either in conjunction with colloquia listed below or by special arrangement with graduate instructors. When research seminars are not offered, independent research in a desired area may be worked out with the Director of Graduate Studies and the appropriate graduate instructor. These seminars do not appear on the official schedule of courses.

401. Seminar on the British Commonwealth. 3 units. *Preston or others of the Committee on Commonwealth Studies*

Colloquia for Graduates

351-352. Colloquia. Each colloquium deals with an aspect of history by means of readings, oral and written reports, and discussion, with attention to bibliography. Ad hoc colloquia may be worked out during registration in the various fields represented by members of the graduate faculty; these colloquia do not appear on the official schedule of courses. In some instances, students may take the equivalent of a research seminar in conjunction with the colloquium and will be credited with an additional 6 units by registering for 371.1-372.1, etc.

Historiography and the Teaching of History—For Graduates

312. Seminar in the Teaching of History in College. The work in this course is intended to acquaint students with the problems involved in teaching history in college. Required of all candidates for the degree of Doctor of Philosophy who are in residence for two years at Duke. As an alternate method of meeting this requirement, a graduate student may, in cooperation with a member of the faculty, serve a one-semester teaching apprenticeship. Year course. No credit. Supervised by Director of Graduate Studies.

314. Historical and Social Science Methodology. Methods used in historical research with emphasis upon the various social science approaches. 3 units. *Chafe*

History 314 or History 280 is required of all candidates for the Ph.D. degree who are in residence for two years at Duke University.

Independent Study

399. Supervised independent study and reading, with consent of professor. 3 units.

Marine Sciences—The University Program

Professor Costlow, *Director*; Professor Emeritus Bookhout (zoology), and Professor Pilkey* (geology); Associate Professors Barbert† (botany and zoology), Forward† (zoology), Gutknecht (physiology), Searles* (botany), Sullivan (biochemistry), and Sutherland (zoology); Adjunct Associate Professor Glaeser* (geology); Assistant Professors Christensen* (botany), McClay* (zoology), Ramus (botany), and Rosendahl* (geology)

Training in the marine sciences at Duke University includes marine biology, marine geology, and oceanography. The departments which are chiefly concerned are botany, chemistry, geology, and zoology.

Graduate students working in the marine sciences will take their degrees under the auspices of one of the above departments and must, therefore, meet the requirements of that department. During the first part of the training the student will usually take courses on the Durham campus during the academic year and enroll in more specialized courses in the marine sciences at the Duke University Marine Laboratory during the summer. After the completion of the course work and preliminary examination (for doctoral candidates) the candidate may, with approval of the major professor, request space for thesis research at the Marine Laboratory.

Persons interested in graduate work in marine sciences should apply through one of the appropriate departments. Forms may be obtained from the Graduate School.

Applications for summer courses at the laboratory should be addressed to the Admissions Office, Duke University Marine Laboratory, Beaufort, North Carolina 28516. The form may be obtained from the *Bulletin of the Marine Laboratory*. The application for enrollment in the Duke University summer session should be accompanied by transcripts of undergraduate and graduate work. Applications should be received as early as possible.

Students registering for research should do so under the appropriate departmental numbers.

The following courses are offered during the summer at Beaufort. See the Marine Laboratory bulletin for the current schedule of courses.

SUMMER COURSES AT BEAUFORT

For Seniors and Graduates

203. Marine Ecology. Application of ecological theory to marine systems. Mathematical properties of population growth and species interactions; field and laboratory projects with computer-assisted analysis of data. Practice in scientific writing. Readings from current scientific publications. Prerequisites: introductory biology or invertebrate zoology, and calculus. Knowledge of statistics is helpful. (Also listed as Zoology 203L.) 6 units. *Sutherland*

204L. Marine Microbiology. The major groups of marine microorganisms, their taxonomy, culture, physiology, and ecology. Prerequisite: a course in

*In residence during summer only.

†On sabbatical academic year 1978.

introductory biology or botany. 6 units. (Also listed as Botany 204L.) *Cavaliere (visiting summer faculty)*

205. Geological Oceanography. Broad geological aspects of the ocean basins including origin, bottom physiology, sediment distribution, and sedimentary processes. Field observations; sampling procedures. Not open to students who have completed Geology 206S. (Also listed as Geology 205.) 6 units. *Glaeser and Pilkey*

211. Marine Phycology. Introduction to marine algae; systematics, morphology, physiology, and ecology. Field trips, laboratory and lectures. (Also listed as Botany 211L.) 6 units. *Searles*

212. Membrane Physiology and Osmoregulation. Physiology of marine and estuarine organisms, with emphasis on cellular transport and electrophysiology. Includes the functions, mechanisms, and comparative aspects of ionic and osmotic regulation in aquatic plants and animals. Laboratory work deals with membrane transport in single cells and epithelia, renal and gill transport in fish, amino acid transport and metabolism in crustaceans, and application of radiotracer and other physical and chemical techniques to the study of membrane function. Prerequisite: consent of instructor. (Also listed as Physiology 212.) 6 units. *Gutknecht and staff*

214. Biological Oceanography. Impact of biological processes on the physical and chemical character of the environment and the regulating role of abiotic processes on organic productivity. Factors regulating primary and secondary productivity with the estuary and ocean as examples. Emphasis on design and execution of directed research. Prerequisite: consent of instructor; introductory biological or chemical oceanography recommended. (Also listed as Zoology 214L.) 6 units. *Barber*

216. Photosynthetic Physiology of Marine Plants. Variations in photosynthetic mechanisms and their ecological consequences in seaweeds and seagrasses. Topics include light capture, carbon reduction pathways, carbon allocation, dark respiration, photorespiration, growth strategies and competitive interaction. Analytical methodologies used in laboratory and field exercises. Prerequisites: introductory biology, organic chemistry and physics or consent of instructor. (Also listed as Botany 216L.) 6 units. *Ramus*

218. Barrier Island Ecology. Adaptation of plants to barrier island migration and other physical characteristics of the coastal environment. Major emphasis will be placed on management of barrier beaches from Maine to Texas and the impact of human interference with natural processes. Field studies. Prerequisite: course in general ecology. (Also listed as Botany 218 and Forestry and Environmental Studies 218.) 6 units. *Godfrey*

230. Environmental Oceanography. Chemical, biological, and geological aspects of pollution in the marine environment. Anthropogenic effects upon natural marine processes on shore lines and shelves. Application of marine science to comparable utilization of marine resources. Prerequisite: consent of instructor; physical chemistry is recommended. (Also listed as Chemistry 230.) 6 units. *Staff*

240. Chemical Oceanography. Distribution, alteration, and transport of chemical species in the marine environment. Field cruises to gather samples for evaluating chemical processes in the ocean. Includes lectures, laboratory work, and field trips. Prerequisite: consent of instructor. Physical chemistry is recommended. (Also listed as Chemistry 240.) 6 units. *Staff*

244L. Diversity of Plants. Surveys major groups of living plants with emphasis on algae, bryophytes, and vascular plants. Field observations and collections stress coastal botany and provide a basis for independent projects. Not open to students who have had Botany 145L. Prerequisite: introductory biology. (Also listed as Botany 144L/244L.) 6 units. *White*

247L. Plant Ecology. Principles of the relationships between plants and their environments. Emphasis on structures and processes of coastal plain ecosystems. Not open to students who have had Botany 246L. Prerequisite: introductory biology. (Also listed as Botany 247L.) 6 units. *Christensen*

250L. Physiological Ecology of Marine Animals. The physiology of marine animals in relation to environmental factors of salinity, temperature, oxygen, and light. Prerequisite: a course in physiology. (Also listed as Zoology 250L.) 6 units. *Forward*

250. Introduction to Marine Geophysics. Topics include seismic reflection and refraction, magnetics, gravity, and seismology. Prerequisite: introductory physics or consent of instructor. (Also listed as Geology 250.) 6 units. *Rosendahl*

274. Marine Invertebrate Zoology. Structures, functions, and habits of invertebrate animals under natural and experimental conditions. Field trips included. Not open to undergraduate students who have had Zoology 175 except with consent of Director of Undergraduate Studies. Prerequisite: introductory biology. (Also listed as Zoology 274L.) 6 units. *Seed (visiting summer faculty)*

276. Comparative and Evolutionary Biochemistry. Lectures and discussion of the origin of life, evolution of the genetic code, mutation and protein polymorphism, natural selection and protein structure, and comparison of homologous proteins and nucleic acids. Laboratory work involves the purification and characterization of homologous proteins from fish and invertebrates. Techniques used include salt fractionation, electrophoresis, ion-exchange and molecular exclusion chromatography, fingerprinting, molecular weight determination, amino acid composition, and other related approaches. Prerequisite: consent of instructor. (Also listed as Biochemistry 276.) 6 units. *Sullivan*

278L. Invertebrate Embryology. Rearing, development, and life histories of invertebrates with emphasis on experimental studies of early developmental stages. Prerequisite: consent of instructor. (Also listed as Zoology 278L.) 3 units. *McClay*

281L. Marine Invertebrate Larvae. Descriptive survey of life cycles, developmental stages, and metamorphosis, with emphasis on larval stages of marine invertebrates, collection, identification, and culture of larval forms in estuarine, inshore and oceanic plankton and sediments. Prerequisites: zoology or consent of instructor. (Also listed as Zoology 281L.) 3 units. *Lehman*

353, 354. Research. Hours to be arranged. Prior approval of instructor at the Duke University Marine Laboratory is required. (For graduate students only.) (Also listed as Zoology 353, 354.) *Staff*

359, 360. Research. Hours to be arranged. Prior approval of instructor at the Duke University Marine Laboratory is required. (For graduate students only.) (Also listed as Botany 359, 360.) *Staff*

Mathematics

Professor Warner, *Chairman* (135C Physics); Professor Reed, *Director of Graduate Studies* (215 Physics); Professors Allard, Arthur, Murray, Schaeffer, Shoenfield, and

Weisfeld; Associate Professors Burdick, Hodel, Kitchen, Kraines, Moore, Scoville, and Smith; Adjunct Associate Professor Chandra; Assistant Professors Flath, Hardorp, Jackson, Pardon, Reznick, Schechter, and Wolpert;

Graduate work in the Department of Mathematics is offered leading to the M.S., A.M., and Ph.D. degrees. Admission to these programs is based on the applicant's undergraduate academic record, level of preparation for graduate study, the Graduate Record Examination, and letters of recommendation.

All A.M. and Ph.D. candidates are required to pass a comprehensive examination after completing their first year of graduate study. The A.M. degree with a major in mathematics is awarded upon completion of 30 units of graded course work and passing the comprehensive examination. A thesis may be substituted for six units of course work only under special circumstances. The department also offers a program in applied statistics with a minor in computer science leading to the M.S. degree.

Candidacy for the Ph.D. is established by passing the comprehensive examination at the Ph.D. level, completing the department's language requirements, and passing an oral preliminary examination. The preliminary examination is normally taken at the beginning of the third year. The preliminary examination is conducted by a committee selected by the rules of the Graduate School and the department. The examination can, at the student's option, consist of either questions based on the student's course work at Duke or on the specific area of research plus a minor subject selected by the student.

After admission to candidacy, the Ph.D. degree is awarded on the basis of the student's scholarly ability as demonstrated by the dissertation and its defense. The dissertation is the most important requirement in the award of the Ph.D. degree.

Mathematics courses 210, 211, 212, 213, and 214 are normally offered in the summer only. For information see the *Bulletin of Duke University Summer Educational Programs*.

For Seniors and Graduates

200. Introduction to Algebraic Structures I. Laws of composition, groups, rings; isomorphism theorems; axiomatic treatment of natural numbers; polynomial rings; division and Euclidean algorithms. Prerequisite: Mathematics 104 or equivalent. 3 units. *Staff*

201. Introduction to Algebraic Structures II. Vector spaces; matrices and linear transformations; fields; extensions of fields; construction of real numbers. Prerequisite: Mathematics 200 or equivalent. 3 units. *Staff*

203. Basic Analysis I. Topology of \mathbb{R}^n , continuous functions, uniform convergence, compactness, infinite series, theory of differentiation, and integration. Prerequisite: Mathematics 104. 3 units. *Staff*

204. Basic Analysis II. Inverse and implicit function theorems, differential forms, integrals on surfaces, Stokes' theorem. Prerequisite: Mathematics 203. 3 units. *Staff*

221, 222. Numerical Analysis I, II. For a description of these courses, see Computer Science 221, 222. 3 units each semester. *Gallie, Patrick, or Utku*

230. Mathematical Methods in Physics and Engineering I. Heat and wave equations; initial and boundary value problems; Fourier series; Fourier transforms; potential theory. Prerequisite: Mathematics 103 and 104 or equivalent. 3 units. *Staff*

231. Mathematical Methods in Physics and Engineering II. Cauchy's theorem; calculus of residues; power and Laurent series; conformal mapping; applica-

tions to fluid flow and potential theory; integral equations; approximation of eigenvalues. Prerequisite: Mathematics 103 and 104 or equivalent. 3 units. *Staff*

234. Mathematics for Quantum Mechanics. Hilbert space; self-adjoint operators; the mathematical model of quantum mechanics; commutation relations; spectral analysis of Hamiltonians; time dependent scattering theory. Prerequisite: Mathematics 230 and 231 or equivalent. 3 units. *Staff*

235. Topics in Mathematical Physics. Group representations, perturbation theory, quantum field theory, statistical mechanics, or general relativity. Prerequisite: Mathematics 231 or equivalent. 3 units. *Staff*

238, 239. Topics in Applied Mathematics. Conceptual basis of applied mathematics, combinatorics, graph theory, game theory, mathematical programming, or numerical solution of ordinary and partial differential equations. Prerequisite: Mathematics 103 and 104 or equivalent. 6 units. *Staff*

240. Applied Stochastic Processes. Applications of probability theory and stochastic processes to economics and environmental science. Markoff chains, optional stopping, queuing theory, decision theory, birth and death processes, and the Monte-Carlo method. Prerequisite: Mathematics 135 or equivalent. 3 units. *Staff*

241. Linear Models. Geometric interpretation; multiple regression; analysis of variance; experimental design; analysis of covariance. Prerequisite: Mathematics 136 or equivalent. 3 units. *Staff*

242. Multivariate Statistics. Multinormal distributions; multivariate general linear model; Hotelling's T^2 statistic; Roy union-intersection principle; principal components; canonical analysis; factor analysis. Prerequisite: Mathematics 241 or equivalent. 3 units. *Staff*

248, 249. Topics in Statistics. Analysis of variance, design of experiments, nonparametric statistics, foundations of statistical inference. Prerequisite: consent of instructor. 6 units. *Staff*

250. Introductory Mathematical Logic. First-order logic, completeness theorem, compactness theorem, introduction to recursive functions, incompleteness theorem. Prerequisite: Mathematics 187 or Mathematics 200 or equivalent. 3 units. *Staff*

251. Set Theory I. Zermelo-Fraenkel axioms; ordinals, and cardinals; models of set theory; constructible sets. Prerequisite: Mathematics 187 or Mathematics 200 or equivalent. 3 units. *Staff*

252. Set Theory II. Forcing, large cardinals, determinateness, and other advanced topics. Prerequisite: Mathematics 251. 3 units. *Staff*

258, 259. Topics in Logic. Model theory, recursion theory, set theory, or other fields of logic. Prerequisite: Mathematics 250 or equivalent. 6 units. *Staff*

260. Groups, Rings, Modules. Elementary categorical algebra; groups, rings; modules; linear and multilinear algebra. Prerequisite: Mathematics 201 or equivalent. 3 units. *Staff*

261. Commutative Algebra. Fields; Noetherian rings and modules; Dedekind domains. Prerequisite Mathematics 260 or equivalent. 3 units. *Staff*

268, 269. Topics in Algebra. Algebraic number theory, algebraic K-theory, homological algebra, or topological algebra. Prerequisite: Mathematics 260. 6 units. *Staff*

270. General Topology. Basic topological properties, including compactness, connectedness, separation axioms, and countability properties; metric spaces and completeness; product spaces and function spaces. Prerequisite: Mathematics 139 or equivalent. 3 units. *Staff*

271. Algebraic Topology. Fundamental group and covering spaces; homology groups of cell complexes; classification of compact surfaces; the cohomology ring and Poincaré duality for manifolds. Prerequisites: Mathematics 171S and 200 or equivalent. 3 units. *Staff*

278-279. Topics in Topology. Point set, algebraic, geometric, or differential topology. Prerequisite: consent of instructor. 6 units. *Staff*

280. Differential Analysis. Differential calculus; ordinary differential equations; flows; Lie bracket; total differential equations; first order partial differential equations; deRham theory. Prerequisite: Mathematics 140 or equivalent. 3 units. *Staff*

281. Real Analysis I. Measures; Lebesgue integral; L^p -spaces; Daniell integral, differentiation theory, product measures. Prerequisite: Mathematics 140 or equivalent. 3 units. *Staff*

282. Real Analysis II. Metric spaces; fixed point theorems; Baire category theorem; Banach spaces; fundamental theorems of functional analysis; Fourier transform. Prerequisite: Mathematics 281 or equivalent. 3 units. *Staff*

283. Linear Operators. Bounded and unbounded operators on Banach and Hilbert spaces; symmetric and self-adjoint operators; Banach algebras; spectral theorem; unitary groups; compact operators; Fredholm theory; accretive operators; semigroups of operators. Prerequisite: Mathematics 282 or equivalent. 3 units. *Staff*

284. Topics in Functional Analysis. Advanced spectral analysis, operator algebras, nonlinear functional analysis, or structure theory of Banach spaces. Prerequisite: Mathematics 282 or equivalent. 3 units. *Staff*

285. Complex Analysis. Complex calculus; conformal mapping; Riemann mapping theorem, Riemann surfaces. Prerequisite: Mathematics 140 or equivalent. 3 units. *Staff*

286. Topics in Complex Analysis. Geometric function theory, function algebras, several complex variables, uniformization, or analytic number theory. Prerequisite: Mathematics 285 or equivalent. 3 units. *Staff*

288, 289. Topics in Analysis. Harmonic analysis, dynamical systems, geometric measure theory, or calculus of variations. Prerequisite: Mathematics 281 and 285 or equivalent. 6 units. *Staff*

290. Probability. Random variables; independence; expectations; laws of large numbers; central limit theorem; Markoff chains. Prerequisite: Mathematics 281 or equivalent. 3 units. *Staff*

291. Stochastic Processes. Measures on function spaces; conditional expectation; Markoff processes; martingales; diffusions; Brownian motion and stochastic integrals. Prerequisite: Mathematics 290 or equivalent. 3 units. *Staff*

293, 294. Topics in Probability Theory. Ergodic theory, multiparameter stochastic processes and random fields, stochastic control theory, or stochastic differential equations. Prerequisite: Mathematics 291 or equivalent. 6 units. *Staff*

297. Fourier Analysis and Distribution Theory. Tempered distributions, Fourier transforms, classical inequalities, oscillatory integrals. Prerequisites: Mathematics 140 and 285 or equivalent. 3 units. *Staff*

298. Partial Differential Equations I. Fundamental solutions of linear partial differential equations, hyperbolic equations, characteristics; Cauchy-Kovalevska theorem; propagation of singularities. Prerequisite: Mathematics 297 or equivalent. 3 units. *Staff*

299. Partial Differential Equations II. Elliptic boundary value problems; regularity theorems; the diffusion equation; nonlinear equations. Prerequisite: Mathematics 298 or equivalent. 3 units. *Staff*

358-359. Current Research in Logic. 6 units. *Staff*

368-369. Current Research in Algebra. 6 units. *Staff*

378-379. Current Research in Topology. 6 units. *Staff*

387. Current Research in Mathematical Physics. 3 units. *Staff*

388-389. Current Research in Analysis. 6 units. *Staff*

Program in Medieval and Renaissance Studies

The graduate Program in Medieval and Renaissance Studies is administered by the Duke University Committee on Medieval and Renaissance Studies. For a description of the program see the chapter on Special and Cooperative Programs; for a description of individual courses see listings under the specified department.

DEPARTMENT OF ART

233. Early Medieval Architecture. *Sunderland*

DEPARTMENT OF CLASSICAL STUDIES

Latin

221. Medieval Latin I. *Newton*

222. Medieval Latin II. *Newton*

225. Paleography. *Newton*

305. Latin Seminar V. Prerequisite: consent of instructor. *Newton*

306. Latin Seminar VI. Prerequisite: consent of instructor. *Newton*

312. Proseminar in Latin Paleography. *Newton*

Classical Studies

327. Seminar in Byzantine History. *Rigsby*

DEPARTMENT OF ENGLISH

207. Old English Grammar and Readings. *Nygard or Reiss*

208. History of the English Language. *Nygard or Reiss*

210. Old English Literary Tradition. *Nygard or Reiss*

212. Middle English Literary Tradition. *Nygard or Reiss*

215, 216. Chaucer. *Nygard or Reiss*

221. English Prose and Poetry of the Sixteenth Century. *DeNeef*

223. Spenser. *DeNeef*

224. Shakespeare. *Williams*

225, 226. Tudor and Stuart Drama, 1500-1642. *Randall*

229. English Literature of the Seventeenth Century. *Williams*

232. Milton. *Staff*

310. Beowulf. *Nygard*

312. Studies in Middle English Literature. *Nygard or Reiss*

315. Studies in Chaucer. *Nygard or Reiss*

318. Medieval Romances. *Reiss*

320. Studies in Renaissance English Prose. *Staff*

324. Studies in Shakespeare. *Williams*

- 325. Studies in the English Drama of the Sixteenth and Seventeenth Centuries. *Randall*
- 329. Studies in the Metaphysical Poets. *DeNeef or Williams*
- 383. Textual Criticism. *Williams*

DEPARTMENT OF GERMANIC LANGUAGES AND LITERATURE

- 205, 206. Middle High German. *Rosenberg*
- 215S. Seventeenth-Century Literature. *Borchardt*
- 216. History of the German Language. *Rosenberg*
- 217S. Renaissance and Reformation Literature. *Borchardt*

DEPARTMENT OF HISTORY

- 221. Problems in the Economic and Social History of Europe, 1200-1700. *Witt*
- 222. Problems in European Intellectual History, 1250-1550. *Witt*
- 237S. Europe in the Early Middle Ages. *Young*
- 238S. Europe in the High Middle Ages. *Young*
- 267S-268S. From Medieval to Early Modern England. *Ferguson*

DEPARTMENT OF PHILOSOPHY

- 218S. Medieval Philosophy. *Mahoney*

DEPARTMENT OF RELIGION

- 206. Christian Mysticism in the Middle Ages. *Raitt*
- 219. Augustine. *Gregg*
- 236. Luther and the Reformation in Germany. *Steinmetz*
- 241. Problems in Reformation Theology. *Steinmetz*
- 251. The Counter-Reformation and the Development of Catholic Dogma. *Raitt*
- 334. Theology and Reform in the Later Middle Ages. *Steinmetz*
- 338. Calvin and the Reformed Tradition. *Steinmetz or Raitt*
- 339. The Radical Reformation. *Steinmetz*
- 344. Zwingli and the Origins of Reformed Theology. *Steinmetz*

DEPARTMENT OF ROMANCE LANGUAGES

French

- 213. French Literature of the Seventeenth Century. *Staff*
- 214. The "Moralistes" of the Seventeenth Century. *Staff*
- 219. Old French Literature. *Vincent*
- 224. History of the French Language. *Hull*
- 225. French Prose of the Sixteenth Century. *Tetel*
- 226. Topics in Renaissance Poetry. *Tetel*
- 311, 312. French Seminar. (Medieval and Renaissance Topics). *Cordle, Niess, Stewart, Tetel, and Vincent*

Italian

- 284. Dante. *Caserta*
- 285. Dante. *Caserta*
- 288. The Renaissance. *Tetel*

Spanish

- 251. The Origins of Spanish Prose Fiction. *Wardropper*
- 252. Spanish Lyric Poetry before 1700. *Wardropper*
- 253. The Origins of the Spanish Theater. *Wardropper*
- 257. History of the Spanish Language. *Garci-Gómez*
- 258. Medieval Literature. *Garci-Gómez*
- 265. Cervantes. *Wardropper*
- 266. Drama of the Golden Age. *Wardropper*
- 321, 322. Hispanic Seminar (Medieval and Renaissance Topics). *Fein, Garci-Gómez, Osuna and Wardropper*

Microbiology and Immunology

Professor Joklik, *Chairman* (414 Jones); Professor Willett, *Director of Graduate Studies* (420 Jones); Professors Amos, Burns, Day, Metzgar, Osterhout, Rosse, and Wheat; Associate Professors Bolognesi, R. Buckley, Cresswell, Dawson, Lang, Levy, Scott,

Seigler, Smith, Snyderman, Vanaman, and Ward; Assistant Professors C. Buckley III, Collins, Endow, Gooding, Koren, Lauf, Leis, and Mitchell; Assistant Medical Research Professors Cambier, Corley, Hershfield, and Miller

The department offers graduate work leading to the Ph.D. degree. Specialization is possible in molecular virology, viral oncology, cell biology, microbial physiology, immunochemistry, immunogenetics, cancer immunology, and general immunology.

Undergraduate preparation in biochemistry and physical chemistry is required. A brochure describing the Ph.D. degree program, prerequisites for admission, and research in the department can be obtained by writing the Director of Graduate Studies, Box 3020, Duke Medical Center.

214. Fundamentals of Electron Microscopy. An introduction to the basics of electron microscopy, specimen preparation, and ultramicrotomy. Open only to graduate students in microbiology and immunology. Offered only in the summer. 2 units. *Miller*

219. Molecular and Cellular Bases of Development. See course description for Anatomy 219. (Also listed as Biochemistry 219, Pathology 219, and Physiology 230.) Fall. *Padilla and staff*

219S. Seminar. Optional seminar offered in conjunction with Microbiology 219.

221. Medical Microbiology. An intensive study of common bacteria, viruses, fungi, and parasites which cause disease in man. The didactic portion of the course focuses on the nature and biological properties of microorganisms causing disease, the manner of their multiplication, and their interaction with the entire host as well as specific organs and cells. 4 units. *Joklik and staff*

233. Principles of Microbiology and Immunology. Physiology and molecular biology of bacteria, the properties of bacterial and animal viruses, and basic immunology. Prerequisites: Chemistry 152 and Zoology 160 or Biochemistry 248. (Also listed as Botany 233L.) 3 units. *Burns, Dawson, Joklik, and Willett*

242. Mechanisms of Microbial Pathogenicity. A lecture-seminar course on the principles and problems of host-parasite interactions at the cellular and molecular level. Emphasis will be on the roles of microbial structures and products in the virulence and pathogenesis of acute, chronic, and toxigenic infectious disease systems. Prerequisites: Biochemistry 248 and Microbiology 233, or equivalents. 2 units. *Wheat*

244. Principles of Immunology. An introduction to the molecular and cellular basis of the immune response. Topics include the anatomy of the lymphoid system, lymphocyte biology, antigen-antibody interactions, humoral and cellular effector mechanisms and control of immune responses. Prerequisites: Zoology 160, and Chemistry 152. (Also listed as Zoology 244.) 3 units. *Dawson and staff*

252. General Virology and Viral Oncology. The first half will be a discussion of the structure and replication of mammalian and bacterial viruses with special emphasis on the molecular and functional aspects. A second part will deal specifically with tumor viruses, discussed in terms of the virus-cell interaction and the response to the host. The relationship of virus infection to neoplasia will be emphasized. 4 units. *Joklik, Keene, and Smith*

282. Molecular Microbiology. Structure, growth, and replication of bacteria with a detailed analysis of informational and catalytic macromolecules. Major topics discussed are: biochemistry and function of structural components, genetic

and metabolic regulatory mechanism, RNA and protein synthesis, and the enzymology of DNA replication. Prerequisite: general biochemistry. 4 units. *Burns, Leis, and Vanaman*

291. Basic Immunology. Structure and function of immunoglobulins. Characteristics of synthetic and natural antigens. Specificity and cross-reactivity. Methods of immunologic analysis. Cellular aspects and kinetics of antibody formation. Forms of immunologic responsiveness and unresponsiveness. Cellular cooperation. Elicitation and control of immune responses. 3 units. *Scott, Dawson, Snyderman, and Corley*

296. Immunochemistry. The structures, bioassembly, and reactions of the immunoglobulins. Primary and conformational aspects of the immunoglobulin chains—sequences, subgroups, domains, allotypes, evolution. The antibody binding site—location, specificity, idiotypes, antigen accommodation. Affinity, heterogeneity, homogeneous binding, kinetics. Sequential, conformational, and quaternary determinants. Active centers of multivalent antigens. The immune responses, affinity and immunoselection, T and B cells. 3 units. *Day, Cresswell, Dawson, and Sage*

For Graduates

323. Readings in Bacteriology and Immunology. A course of readings and syntheses in restricted areas of bacteriology and immunology under the direction of individual staff members. 2 units. *Staff*

325. Medical Mycology. Comprehensive lecture and laboratory coverage of all the fungi pathogenic for humans. Practical aspects as well as future trends in the mycology, immunology, diagnosis, pathogenesis, and epidemiology of each mycotic agent will be explored. There will be several invited lecturers, each an internationally recognized scientist, discussing their particular areas of mycological expertise and current research. Prerequisite: consent of instructor. 4 units. *Mitchell*

330. Medical Immunology. A course designed to present the basic concepts of immunology as they relate to human disease. Emphasis will be on tumor immunology, autoimmunity, neuroimmunology, immunoematology, and immunologic deficiency diseases. 6 units. *Levy and staff*

331.1-331.8. Microbiology Seminar. Current topics in microbiology with seminars presented by students, faculty, and outside speakers. Required course for all students specializing in microbiology. 1 unit each semester. *Staff*

332.1-332.8. Immunology Seminar. Current topics in immunology with seminars presented by students, faculty, and outside speakers. Required course for all students specializing in immunology. 1 unit each semester. *Staff*

336. Immunogenetics. Antigens of tissues and organs, distribution, extraction, and chemistry. Phylogeny of iso-antigenic systems of man and animals. Tests for histocompatibility including lymphocyte interactions and reactivity. Change in antigenicity and immune responsiveness in carcinogenesis. Immunologic factors in pregnancy and in homotransplantation of organs. (Also listed under the University Program in Genetics.) 2 units. *Amos and Ward*

420. Cellular Immunophysiology. See course description for Physiology 420. (Also listed as Physiology 420.) 2 units. *Lauf and staff*

Pathology

Professor Jennings, *Chairman* (301B Davison); Professor Bigner, *Director of Graduate Studies* (216 Jones); Professors Fetter, Hackel, Johnston, Klintworth, Pratt, Sommer, Vogel, and Wittels; Associate Professors Adams, Bossen, Bradford, Burger, Daniels, Elchlepp, Graham, Shelburne, Tisher, Widmann, and Zwadyk; Assistant Professors Anderson, Crocker, Hawkins, Lewis, McCarty, Michalopoulos, Pizzo, Reimer, and Vollmer; Adjunct Assistant Professors Brody and Moore

The Department of Pathology offers graduate work leading to the M.S. and Ph.D. degrees with areas of specialization such as subcellular and molecular pathology. Course work is designed to give a broad background in classical and modern pathology with emphasis on the application of modern research techniques. Students will be required to take such courses as are necessary to obtain a broad foundation, as well as courses applicable to areas of speciality and research. Further information including brochures giving details of departmental facilities, staff, trainee stipends, and the M.D.-Ph.D. program are available from the Director of Graduate Studies.

219. Molecular and Cellular Bases of Development. For a description of the course see Anatomy 219. (Also listed as Biochemistry 219, Microbiology 219, and Physiology 230.) Fall. 3 units. *Padilla and staff*

219S. Seminar. Optional seminar offered in conjunction with Pathology 219.

250. General Pathology. The fundamentals of pathology are presented to the student. Lectures developing broad concepts of disease processes are given by the members of the senior staff. The emphasis is placed on etiology and pathogenesis of disease. Lectures. Prerequisites: histology and consent of instructor. 4 units. *Hackel or staff*

251. Laboratory Course in General Pathology. Laboratory session to complement 250. Gross and microscopic material is correlated with and related to disease processes. Pathology 250 may be taken concurrently. Prerequisites: histology and consent of instructor. 4 units. *Hackel or staff*

258. Cellular and Subcellular Pathology. This course is designed for students wishing to broaden their knowledge of cellular structure and cellular pathology. The course consists of lectures and seminars discussing the alterations in cellular structure and associated functions that accompany cell injury. Prerequisite: consent of instructor. Fall only. Hours to be arranged. 2 units. *Shelburne, Hawkins, and Sommer*

275. Fundamentals of Electron Microscopy. Theoretical basis of practical electron microscopy. Areas to be discussed include the nature of light and electrons, light and electron optics, image recording and processing by photographic and other methods, specimen preparation, functional anatomy of the electron microscope, and several special techniques. Student presentations and selection of special topics will be encouraged. The approach will be nonmathematical, but college physics is strongly recommended. Practical laboratory experience will be included. Fall only. 2 units. *Shelburne, Hawkins, or Sommer*

325. Cardiovascular Pathology. Cardiovascular disease processes will be studied, reviewing anatomic, embryologic, and physiologic features, and utilizing case material and gross specimens. Consideration will be given to principles of electrocardiography. Prerequisite: consent of instructor. Fall only. 3 units. *Hackel*

352. Basic Problems in Chemical Pathology. This is an advanced seminar tutorial course in which the biochemical and physiological expressions of

morphologic abnormalities will be explored. Specific organ systems will be used as a model for instruction and discussion. Experimental approaches toward solutions of problems will be discussed. Prerequisite: consent of instructor. 2 units. *Wittels*

353. Advanced Neuropathology. This course deals with current problems and research methods related to diseases which affect the nervous system. Prerequisite: consent of instructor. Fall only. 2 units. *Vogel*

355, 356. Graduate Seminar in Pathology. Discussions outlining the scope of modern pathology. This will include reports of original researchers by members of staff and visitors. Fall and spring. 2 units. *Bigner and staff*

357. Research in Pathology. Independent research projects in various fields of pathology. Hours and credit to be arranged. *Jennings and staff*

360. Cytochemistry. Theory and application of cytochemical techniques for investigating the presence and localization in cells of various substances such as proteins, lipids, carbohydrates, and enzymes at the light and/or electron microscopic level, including radioautography. Some laboratory experience. Maximum enrollment six. Spring only. 2 units. *Sommer, Hawkins, or Shelburne*

361, 362. Autopsy Pathology. A detailed consideration of the morphologic, physiologic, and biochemical manifestations of disease. Emphasis is on individual work in the laboratory with tutorial supervision. Gross dissection, histologic examination, processing, and analyzing of morphologic, microbiologic, and biochemical data, and interpretation of results. For advanced students. Prerequisites: Pathology 250 and consent of instructor. 3 to 6 units each semester. *Adams and staff*

364. Systemic Pathology. Systematic presentation of the characteristics of disease processes as they affect specific organ systems. Prerequisite: consent of instructor. 6 units. *Hackel and staff*

367, 368. Special Topics in Pathology. Special problems in pathology will be studied with a member of the senior staff; the subject matter will be individually arranged. Hours to be arranged. 2 to 4 units. *Jennings and staff*

369. Ophthalmic Pathology. This course will consist of lectures, seminars, and laboratory sessions. The normal anatomy and embryology of the eye will be reviewed as a basis for the study of the various ocular disease processes. The more common diseases of the eye will be considered in detail. Problems in ophthalmic pathology will be discussed together with methods of solving them. Fall only. 3 units. *Klintworth*

370. Developmental Pathology and Teratology. A systematic study of disease processes involving the prenatal, natal, and postnatal period. Emphasis will be placed on developmental anatomy and teratogenesis. The format includes seminars and clinicopathologic correlations derived from gross and microscopic material. Prerequisites: Pathology 250, anatomy, and histology. Spring only. 3 units. *Bradford*

374. Pulmonary Pathology and Postmortem Pathophysiology. Emphasis will be on pulmonary pathology and pathophysiology of infectious, metabolic, environmental, and neoplastic diseases, and certain diseases of unknown etiology (e.g., sarcoid, alveolar proteinosis, etc.). Ventilatory experiments will be done on excised human lungs. Fall. 3 units. *Pratt*

377. Pathology of the Kidney. The course includes a comprehensive study of pathological, immunological, and clinical features of the glomerulonephritis, and pyelonephritis, as well as of metabolic, congenital, and neoplastic renal disorders.

Lectures will be supplemented with gross and microscopic specimens, demonstrations, and special library studies. Fall. 3 units. *Tisher or Croker*

379. Pathology of Virus Infections. The pathological effects of viruses will be discussed. A series of lectures and student-conducted seminars concerning the structural, biochemical, and functional alterations associated with virus-cell interactions. Prerequisites: Pathology 250 and 251. Fall. 4 units. *Daniels*

381. Interdisciplinary Seminars in Cancer Research. Emphasis of the course will be on cellular biology of the cancer cell. The instructors will present topics on aspects of cancer research and will attempt to correlate them with the biologic and clinical behavior of specific forms of neoplasia. 4 units. *Michalopoulos and Falletta*

Pharmacology

Professor Kirshner, *Chairman* (437 Medical Sciences I); Associate Professor Mills, *Director of Graduate Studies* (432 Medical Sciences I); Professors Bernheim, Lack, Maxwell, Menzel, Nichol, Ottolenghi, Schanberg, Shand, Wilder; Associate Professors Davis, Rosen, Slotkin, Viveros; Assistant Professors Abou-Donia, Bjornsson, Conn, Ellinwood, Gardner, Kuhn, Lazar, Nadler, Namm, Shrivastav, Strauss, Whorton, Wilson.

The Department of Pharmacology offers graduate work leading to the Ph.D. degree. The department considers a strong background in basic science as necessary, serious consideration being given to candidates with majors in biology, chemistry, mathematics, and physics. There is no foreign language requirement.

For Seniors and Graduates

210, 211. Individual Study and Research. Directed reading and research in pharmacology. Prerequisites: senior standing and consent of the Director of Graduate Studies. Fall and Spring. 3 to 9 units each semester. *Staff*

219. Tutorial in Pharmacology. Guided independent study of original literature. Fall and Spring. Credit to be arranged. *Staff*

250. Pharmacology. A core course in pharmacology describing the action of drugs in terms of biochemical and physiological processes, and the rationale for their use in clinical therapy. Four lectures, one clinical correlation and one conference per week. Spring. 4 units. *Staff*

256. Human Nutrition. Nutrition principles with emphasis on physiology and pharmacology. Topics include the chemical basis for nutrient requirements, application to practical diets, parenteral nutrition, influence of dietary intake on disease (cardiovascular disease, diabetes, and inborn errors of metabolism), optimal dietary intake, impact of food technology on human nutrition, growth, maturation, and lactation and their requirements and recent advances in micronutrient requirements. (Offered Fall beginning 1980.) 2 units. *Menzel*

270. Neurobiology 1. Interdisciplinary approach to neuronal function at the cellular and molecular levels. Topics will include: subcellular structural organization, physiology and pharmacology of excitable membranes, impulse generation and conduction, neurotransmitters, proteins, pre- and post-synaptic organization and function. 3 units. *Moore and staff*

271. Neurobiology 2. An integrated view of the central nervous system, taught by members of the Departments of Anatomy, Pharmacology, Physiology and Psychology. Sensory systems; motor systems; sleep and alerting; transmitters and behavior; pathologic discharges; evolutionary and comparative aspects. 3 units. *Somjen and staff*

280. Student Seminar in Pharmacology. Preparation and presentation of seminars to students and faculty on topics of broad interest to pharmacology. Required of all pharmacology graduate students. Fall and spring. 2 units. *Bernheim*

282. Teaching Methods in Pharmacology. Participation with departmental staff in various teaching modes. Lectures, conferences, tutorials, and preparation of self-instructional teaching materials. Available only to graduate students in the Department of Pharmacology. Fall, spring, and summer terms. Credit to be arranged. *Staff*

For Graduates

330. Pharmacological Basis of Clinical Medicine. Detailed analysis of the mechanisms of action and rationale for use of pharmacologic agents in disease states. Fall. 4 units. *Schänberg and staff*

331. Laboratory Methods in Pharmacology. Tutorial laboratory training in various fields of pharmacology including neuropharmacology, cardiovascular pharmacology, biochemical pharmacology, and biophysical pharmacology. Prerequisite: consent of instructor. Fall and spring. 3 to 6 units. *Staff*

333. Principles of Pharmacology and Toxicology, I. Drug absorption, distribution, excretion and metabolism, basic and clinical pharmacokinetics, Hansch correlation of structure and activity, stereochemistry and drug action. May be taken separately from Pharmacology 334. Offered alternate fall semesters beginning 1979. 3 units. *Slotkin and staff*

334. Principles of Pharmacology and Toxicology, II. Drug receptor theory and its practical applications, pharmacokinetics and pharmacodynamics of toxic substances, mechanisms of toxicity, adverse drug reactions and interactions. May be taken without Pharmacology 333 with permission of instructor. Offered alternate spring semesters beginning 1980. 3 units. *Rosen, Menzel and staff*

335. Drug Receptor Theory. Development of receptor theory from the standpoint of kinetic models; adaptation of theory to the qualitative evaluation of receptors by biochemical, physiological, and pharmacological criteria. Prediction of receptor properties. (Receptors of the autonomic nervous system and hormone responsive cells will be emphasized.) (Offered alternate years beginning spring 1979.) 3 units. *Rosen*

354. Mammalian Toxicology. Principles of toxicology as related to man. Emphasis on the molecular basis for toxicity of chemical and physical agents. Subjects include the limitations and assumptions of extrapolation to man from animal toxicity, safety drugs and food additives, toxicity of pesticides and their hazard to man, and the role of scientists in societal decisions on the use of man-made chemical and physical agents. (Offered fall beginning 1980.) *Menzel, Abou-Donia, and staff*

360. Neuropharmacology. Central and peripheral transmitter mechanisms and their control; mechanisms of action of drugs used to modify nervous system function; interactions of neural and endocrine systems. Prerequisites: Physiology 200 and Pharmacology 250 or consent of instructor. Fall. 3 units. *Nadler*

372. Research in Pharmacology. Laboratory investigation in various areas of pharmacology. Fall and spring. Credit to be arranged. *Staff*

417. Cellular Endocrinology. Current concepts of the mechanisms of action of hormones at the cellular level, including hormone-receptor interactions; secondary messenger; regulation of protein synthesis; growth and differentiation; control

of salt and water balance; regulation of substrate storage and mobilization; modulation of hormone secretion. (Also listed as Physiology 417.) Fall. 2 units. *Lebovitz*

Philosophy

Professor Golding, *Chairman* (201E West Duke); Professor Sanford, *Director of Graduate Studies* (201D West Duke); Professors Mahoney, Peach, and Welsh; Associate Professor Roberts; Assistant Professors Fjeld, Ross, and Wartenberg

The Department of Philosophy offers graduate work leading to the A.M. and Ph.D. degrees. Tutorial work complements formal instruction. Students may specialize in any of the following fields: the history of philosophy, logic, philosophy of science, epistemology, metaphysics, philosophy of mind, philosophical analysis, ethics, aesthetics, political philosophy, philosophy of law, philosophy of medicine, and philosophy of religion.

Individual programs of study are developed for each student. The following requirement, however, is fundamental: the preliminary examination for the Ph.D., which may be taken only after a student has met the language requirement for that degree, should be taken after the second year of study. In these examinations students are expected to combine historical knowledge with critical understanding.

Work in a minor or related field, not necessarily confined to any one department, is encouraged but not required. A minor normally includes 6 units for the A.M. or the Ph.D. degree and may include more as a student's program requires or permits.

A student who meets the general requirements of the Graduate School for the A.M. degree may earn this degree by satisfying the foreign language requirement and by passing the preliminary examination for the Ph.D. degree or by writing and successfully defending a master's thesis.

A reading knowledge of at least one foreign language, ancient or modern, is required for the Ph.D. degree. Students may not take their preliminary examinations until they have demonstrated this ability. More than one language may be required where this is judged appropriate to the research demanded by the candidate's dissertation.

For Seniors and Graduates

202S. Aesthetics: The Philosophy of Art. A study of some fundamental issues in aesthetics with particular reference to the fields of literature, music, and painting. Problems discussed include the role of standards in criticism, aesthetic judgment, interpretation, evaluation in the arts, meaning in the arts, art and truth, the arts and morality. Open to juniors with the consent of the instructor. 3 units. *Welsh*

203S. Contemporary Ethical Theories. Study of the nature and justification of basic ethical concepts in the light of the chief ethical theories of twentieth-century British and American philosophers. 3 units. *Roberts*

204S. Philosophy of Law. Natural law theory and positivism; the idea of obligation (legal, political, social, moral); and the relation of law and morality. 3 units. *Golding*

205S. Philosophy of History. The nature of historical knowledge and inquiry; theories of the historical process. 3 units. *Staff*

206S. Responsibility. Investigation of the relationship between responsibility in the law and moral blameworthiness; excuses and defenses; the roles of such concepts as act, intention, motive, ignorance, and causation. 3 units. *Golding*

208S. Political Values. Analysis of the systematic justification of political principles and the political values in the administration of law. 3 units. *Golding*

211S. Plato. Selected dialogues. 3 units. *Fjeld*

217S. Aristotle. *Metaphysics* or the *Nicomachean Ethics*. 3 units. *Fjeld*

218S. Medieval Philosophy. Selected problems in medieval philosophy. (Also listed under Medieval and Renaissance Studies.) 3 units. *Mahoney*

225S. British Empiricism. A critical study of the writings of Locke, Berkeley, or Hume with special emphasis on problems in the theory of knowledge. 3 units. *Peach*

227S. Continental Rationalism. A critical study of the writings of Descartes, Spinoza, or Leibniz with special emphasis on problems in the theory of knowledge and metaphysics. 3 units. *Peach*

228S. Recent and Contemporary Philosophy. A critical study of some contemporary movements in philosophy with special emphasis on the work of Moore, Russell, Wittgenstein, Wisdom, and Ryle. 3 units. *Welsh*

230S. The Meaning of Religious Language. See course description for Religion 230. (Also listed as Religion 230.) 3 units. *Poteat*

231S. Kant's Critique of Pure Reason. 3 units. *Wartenberg*

232S. Recent Continental Philosophy. Selected topics. 3 units. *Wartenberg*

233S. Methodology of the Empirical Sciences. Recent philosophical discussion of the concept of a scientific explanation, the nature of laws, theory and observation, probability and induction, and other topics. Prerequisite: consent of instructor. 3 units. *Ross*

234S. Problems in the Philosophy of Science. Selected problems in the physical and nonphysical sciences such as space and time, measurement and determinism. Prerequisite: consent of instructor. 3 units. *Ross*

241S. Topics in Logical Theory. 3 units. *Staff*

251S. Epistemology. Selected topics in the theory of knowledge, e.g., conditions of knowledge, scepticism, and certainty, perception, memory, knowledge of other minds, and knowledge of necessary truths. 3 units. *Sanford*

252S. Metaphysics. Selected topics: substance, qualities and universals, identity, space, time, causation, and determinism. 3 units. *Sanford*

253S. Philosophy of Mind. Analysis of concepts such as thought and belief; issues such as mind-body relations, thought and action, the nature of persons and personal identity. 3 units. *Roberts*

254S. Philosophy of Religion. Topics such as proofs of the existence of God, meaningfulness of religious language, the problems of evil, immortality, and resurrection. 3 units. *Roberts*

255S. Philosophy of Action. Problems in the individuation, characterization, and explanation of human actions; an analysis of such concepts as choosing, deciding, intending, doing, making, letting. 3 units. *Sanford*

260S. Wittgenstein. An examination of the *Tractatus* or the *Investigations*. 3 units. *Welsh*

291S, 292S. Seminar in Special Fields of Philosophy. 3 units each semester. *Graduate staff*

For Graduates

331, 332. Seminar in Special Fields of Philosophy. 3 units each semester.
Graduate staff

Physical Therapy

Professor Bartlett, *Chairman* (045 Hospital); Associate Professor Branch, *Director of Graduate Studies* (045 Hospital); Associate Professor Villanueva; Assistant Professor Horton; Assistant Clinical Professors Eckel and Riordan; Associates Cannon, George, and Huse; Adjunct Assistant Professor Roses

The Department of Physical Therapy offers a basic professional program leading to the M.S. degree. To be eligible for admission to the program, applicants must have obtained a baccalaureate degree and have a background in the basic sciences and social sciences including course work in biology, chemistry, physics, psychology, and statistics. In the first year of the curriculum students are required to take courses in anatomy offered by that department. Further information may be obtained from the Director of Graduate Studies, Department of Physical Therapy, Box 3965, Duke University Medical Center, Durham, North Carolina 27710.

201, 202. Seminar in Physical Therapy. Historical background and trends in the profession; orientation to physical therapy departmental organization and administration; professional and community relationships; professional ethics; methods of communication; and literature review. Units by arrangement. *Bartlett*

217. Physical Therapy Dynamics I. Orientation to patient care; principles of biomechanics; principles and practice of selected mechanical, electrical, and thermal agents. 3 to 4 units. *Branch, Villanueva, and Eckel*

218. Physical Therapy Dynamics II. Regional approach to the process of human movement analysis, including kinesiological analysis of normal and pathological patterns of gait; introduction to therapeutic exercise, with emphasis on rationale and methods of treatment. 3 to 5 units. *Villanueva and Cannon*

220. Physical Therapy Dynamics III. The role of the central nervous system in the inhibition or facilitation of motor behavior as related to the management of patients with central nervous system disorders. Emphasis on the application of current neurophysiological concepts to the evaluation of patients with central nervous system deficits and to the planning and administration of treatment programs. 2 to 4 units. *Cannon*

230, 231. Physical Evaluation and Instrumentation. Principles and techniques of objective assessment and analysis of functional status, including manual muscle tests, dynamometry, goniometry, electrical diagnostic testing, posture analysis, body measurements, evaluation of respiratory and sensory function, disability evaluation, and orientation to electromyography and nerve conduction studies. 2 to 4 units. *Villanueva and staff*

234. Introductory Pathology. Fundamentals of pathology with emphasis on broad concepts of disease processes; systems of the body are studied from the point of view of histological and functional change. 2 to 3 units. *Branch*

236, 237. Medical Sciences. Lectures by clinicians with patient demonstrations and correlation of treatment methods; medical and surgical, neurological, orthopaedic, and emotional conditions affecting human dysfunction; emphasis on psychodynamic principles of patient-therapist relationships. 2 to 4 units. *Staff and special lecturers*

240. Prosthetics and Orthotics. Designed to provide basic knowledge of the effects of prostheses and orthoses on trunk and extremity function, in relation to various skeletal and neuromuscular disorders. Includes components and materials; design and fabrication; principles of fit, alignment and operation of device; evaluation; gait and activities training procedures. 2 to 4 units. *Staff*

242. Directed Clinical Experience in Physical Therapy I. Students are assigned to hospitals, rehabilitation centers, schools for crippled children, extended-care facilities, and public health units for short-term supervised learning experiences. 1 to 2 units. *Staff*

243, 244. Directed Clinical Experience in Physical Therapy II. Students are assigned to full-time learning experiences under direction. 2 to 4 units each semester. *Staff*

297, 298. Special Topics in Physical Therapy. Special problems in physical therapy will be studied with a faculty member; the subject matter will be individually arranged. Units to be arranged. *Staff*

301. Introduction to Scientific Inquiry. Theory and methods of research process; research design; data collection; statistical techniques; preparation and application of research protocol and project. 3 units. *George*

332. Administration of Physical Therapy Services. Principles of administration, leadership styles, and management roles; concepts of systems theory and analysis; planning, organizing, delivering, and evaluating physical therapy systems and subsystems. 3 units. *Bartlett*

350. Research. Units by arrangement. *Staff*

Physics

Professor Walker, *Chairman* (119 Physics); Associate Professor Evans, *Director of Graduate Studies* (111 Physics); Professors Biedenharn, Bilpuch, Cusson, Fairbank, Gordy, Han, Lewis, Meyer, Newson, Roberson, Robinson, and Walter; Adjunct Professors Ciftan, O'Foghlu, Robl, and Way; Associate Professors DeLucia, Fortney, Goshaw; Assistant Professors Lawson, Lucas, Nelson, Palmer, Smith, and Wender

The Department of Physics offers graduate work for students wishing to earn the A.M. or Ph.D. degree. In addition to a balanced program of basic graduate courses, the department offers specialized courses and seminars in several fields, in which research is being done by students, faculty, and staff.

With the help of faculty advisers, students select a course program to fit their needs, including work in a related field, usually mathematics or chemistry. Students are encouraged to begin research work early in their careers.

The department does not ordinarily accept students for work toward the A.M. degree only, and students making good progress are advised to work directly for the Ph.D. degree. The option of taking the A.M. without thesis is available with the approval of a departmental committee.

For Seniors and Graduates

211, 212. Advanced Modern Physics. Quantum theory with applications to the study of atoms, molecules, solids, and nuclei. Prerequisites: Physics 161 and 181, or equivalents; Mathematics 181 and 230, or equivalents (may be taken concurrently). 3 units each semester. *Robinson*

215. Introduction to Quantum Mechanics. Wave mechanics and elementary applications; the hydrogen-like atoms; electron spin and angular momentum;

operators and eigenvalues; stationary state perturbation theory; identical particles. Prerequisites: Physics 161 and 181, and Mathematics 181 and 230 (may be taken concurrently). 3 units. *Biedenharn*

217S, 218S. Advanced Physics Laboratory and Seminar. Experiments involving the fields of mechanics, electricity, magnetism, heat, optics, and modern physics. 6 units. *Meyer*

220. Electronics. Basic elements of modern electronics including a.c. circuits, transfer functions, solid state service, transistor circuits, operational amplifier applications, digital circuits, and computer interfaces. 3 units. *Fortney*

223. Electricity and Magnetism. Electrostatic fields and potentials, boundary value problems, magnetic induction, energy in electromagnetic fields, Maxwell's equations, introduction to electromagnetic radiation. 3 units. *Cusson*

240. Computer Application to Physical Measurement. Discussion and application of various computer interfacing techniques for data acquisition, display, and control in the modern experimental arrangement. Experience with a laboratory computer. Prerequisites: Physics 171 or consent of instructor. 3 units. *Fortney*

280. Nuclear Reactor Physics. Neutron diffusion theory, reactor criticality, kinetics, control, and reactivity effects. Slowing-down of neutrons, age theory, resonance absorption, temperature effects, and multigroup methods. Prerequisites: Physics 161; Mathematics 181 and 230, or equivalents (may be taken concurrently). 3 units. *Cusson*

282. Mechanics of Continuous Media. Small vibrations, rigid body motion, hydrodynamics, elasticity. Prerequisites: Physics 41 and 42, or 51 and 52; differential and integral calculus. 3 units. *Walker*

For Graduates

302. Advanced Mechanics. The fundamental principles of Newtonian mechanics; general dynamics of systems of particles and rigid bodies; the methods of Lagrange and Hamilton; generalized mechanics. 3 units. *Cusson*

303. Statistical Mechanics. Fundamental laws of thermodynamics and statistical mechanics with applications to physics and chemistry. Classical and quantum ideal gasses; approximate methods for real gasses and liquids. Prerequisite: Physics 215. 3 units. *Palmer*

304. Advanced Topics in Statistical Mechanics.* This course will vary from year to year. Possible topics include Fermi liquids, systems of bosons, many-body theory, nonequilibrium statistical mechanics. Prerequisites: Physics 303 and 316. 3 units. *Staff*

305. Introduction to Nuclear Physics. Phenomenological aspects of nuclear physics; interaction of gamma radiation and charged particles with matter; nuclear detectors; particle accelerators; radioactivity; basic properties of nuclei; nuclear systematics; nuclear reactions, particle scattering; nuclear models of the deuteron; nuclear forces; parity. 3 units. *Roberson*

306. Low Temperature Physics.* The properties of matter near the absolute zero of temperature; superconductivity, liquid helium, adiabatic demagnetization. Prerequisite: Physics 303. 3 units. *Fairbank*

308. Introduction to High Energy Physics. High energy processes; electromagnetic, weak, and strong interactions. 3 units. *Walker*

*Offered on demand.

309. Solid State Physics I. Properties of matter in the condensed state; crystal lattices, electrons in metals and semiconductors, band theory, nonmetallic solids, lattice dynamics, and phonons. Prerequisites: Physics 215 and 303. 3 units. *Palmer*

310. Solid State Physics II.* Elementary excitations and their interactions in the condensed state of matter; scattering theory and correlation functions; magnetic interactions in solids, superconductivity; amorphous solids. Prerequisites: Physics 309 and 316. 3 units. *Staff*

312. Phase Transitions and Critical Phenomena. Description of phase transitions in diverse physical systems such as fluids, magnets, mixtures, and superfluids. Experimental techniques and results. Application of the classical methods of thermodynamics, correlation functions, and mean field theory to the critical state of matter. Microscopic models of phase transitions. Modern approaches to static and dynamic critical phenomena such as the theories of critical exponents, scaling, series expansions, critical relaxation, and mode-mode coupling. 3 units. *Staff*

316. Principles of Quantum Theory. Original and fundamental concepts of quantum theory; wave and matrix mechanics; theory of measurements; exclusion principle and electronic spin. Prerequisite: Physics 215 and 302. 3 units. *Biedenbarn*

317. Intermediate Quantum Theory. General operator methods; angular momentum; Dirac electron theory. Second quantization; symmetry principles and conservation theorems. Applications to the theory of solids, of nuclei, and of elementary particles will be stressed. Prerequisite: Physics 316. 3 units. *Evans*

318. Electromagnetic Field Theory. Electrodynamics; theory of wave optics; radiation of electric and magnetic multipole fields; special relativity; covariant electrodynamics; Lienard-Wiechert potentials; scattering and dispersion; Hamiltonian field equations. Prerequisite: Physics 223. 3 units. *Staff*

330. Nuclear Structure Theory.* Two body nuclear forces used to describe nuclear structure; nuclear shell and collective models; properties of nuclear levels; magnetic and quadrupole moments; transition probabilities; nucleon-nucleon scattering; nuclear reactions. Prerequisites: Physics 305 and 316. 3 units. *Staff*

331. Microwave Radiation.* Microwave generators, cavity resonators, transmission lines, radiation propagation, and detection. 3 units. *Gordy*

335. Microwave Spectroscopy.* Application of microwaves in the determination of molecular, atomic, and nuclear properties. Stark and Zeeman effects in microwave spectroscopy. Magnetic resonance absorption. 3 units. *Gordy*

341. Advanced Topics in Quantum Theory.* Introduction to relativistic quantum field theory; Lorentz and Poincaré groups; quantization of free fields; interacting fields and S-matrix; applications of quantum electrodynamics and dispersion relations. Prerequisite: Physics 317. 3 units. *Staff*

342. Theory of Elementary Particles.* Theoretical methods used in treating particle interactions, emphasizing phenomenological treatments. Quantum field theory and dispersion theory is developed as needed. Applications in the general areas of pion physics, electromagnetic interactions of hadrons, strange particle interactions, and weak interactions are surveyed. Prerequisite: Physics 316. 3 units. *Han*

343. Nuclear Physics.* Elementary theory of the deuteron; low energy neutron-proton scattering; theory of nuclear reactions; penetration of potential barriers; nuclear energy levels. Prerequisite: Physics 215. 3 units. *Staff*

344. Advanced Nuclear Physics.* The deuteron, nuclear forces, scattering of elementary particles, beta-radiation. Other aspects of nuclear physics amenable to theoretical interpretation. 3 units. *Biedenbarn*

345. High Energy Physics.* Experimental and theoretical aspects of high energy nuclear processes; properties of mesons and hyperons. 3 units. *Staff*

346. Topics in Theoretical Physics.* The content of this course will vary from year to year. General methods in quantum mechanics such as group theory and its applications; elementary particle theory; field theory; theory of solids; theoretical nuclear physics; atomic and molecular structure. Prerequisites: Physics 316 and 317. 3 units. *Staff*

351, 352. Seminar. A series of weekly discussions on topics related to the research projects under investigation in the department. 2 to 4 units. *Graduate staff*

397, 398. Low Temperature and Solid State Seminar. Weekly seminar on advanced topics and recent research work in the field of low temperature and solid state physics. 2 to 4 units. *Staff*

Physiology

Professor Johnson, *Chairman* (388 Medical Sciences I); Professor Lieberman, *Director of Graduate Studies* (413 Medical Sciences I); Professors Blum, Diamond, Jöbsis, Lauf, Moore, Salzano, Spach, and Somjen; Associate Professors Anderson, Bennett, Erickson, Greenfield, Gutknecht, Kylstra, Lebovitz, McManus, Mandel, Mendell, Mills, Padilla, Schooler, and Wolbarsht; Assistant Professors Carter, Horres, Schomberg, Wachtel, and Wallace; Medical Research Assistant Professors Beall, Baumann, McHale, Ramón, and Simon.

The Department of Physiology offers graduate work leading to the Ph.D. degree. Before undertaking this program a student should have a strong background in basic sciences including course work in mathematics, biology, physics, and chemistry through physical chemistry. Undergraduates with this background may have majors in any of the following areas: biology, chemistry, physics, mathematics, engineering, or computer sciences. There is no foreign language requirement.

For Seniors and Graduates

200. Introduction to the Physiology of Man. Lectures and conferences on cell and organ physiology. Human and medical aspects are stressed in clinical conferences and in laboratory experience. The neurophysiology section is given in a three-week period following the end of the semester. Limited to students whose training requires knowledge of human physiology as it pertains to medicine. Three lectures, two conferences and one laboratory per week. Prerequisite: consent of course leader. Fall. 5 units. *Staff*

204. Introduction to Modern Physiology. Flow of fluids in tubes, ionic transport mechanisms, and endocrine systems are examined in terms of how such processes enter into the functioning of intact organs such as heart, lung, gut, and central nervous system. Particular emphasis is given to the control of physiological function both at the cellular and higher levels of organization. Required of all graduate students in physiology. Others must have consent of instructor. Prerequisites: at least one year each of physics, calculus, and biology; chemistry through organic chemistry; physical chemistry is strongly recommended. Spring. 4 units. *Blum and staff*

207. The Heart in Health and Disease. Physiology at the organ systems level, including cardiac electrophysiology and mechanics, arrhythmias, ventricular-atrial function, cardiogenesis, congenital disorders, coronary blood flow, and cardiovascular control mechanisms. Designed to be most valuable to medical students as part of a coordinated program of study such as the Cardiovascular Study Program. Fall. 2 units. *P. A. Anderson and staff*

208. Respiratory System in Health and Disease. Primary emphasis on the physiology of respiration. Topics include pulmonary mechanics, gas exchange, ventilation-perfusion relationships, central and peripheral regulation of ventilation and respiratory responses to exercise, altitude, and hyperbaric environments. Spring. 2 units. *Salzano and Kylstra*

210. Individual Study. Directed reading and research in physiology. Prerequisites: senior standing and consent of the Director of Graduate Studies. Fall and spring. 3 to 9 units each semester. *Staff*

212. Membrane Physiology and Osmoregulation. Physiology of marine and estuarine organisms, with emphasis on cellular transport and electrophysiology. Includes the functions, mechanisms, and comparative aspects of ionic and osmotic regulation in aquatic plants and animals. Laboratory work deals with membrane transport in single cells and epithelia, renal and gill transport in fish, amino acid transport and metabolism in crustaceans, and application of radiotracer and other physical and chemical techniques to the study of membrane function. Prerequisite: consent of instructor. (Also listed under Marine Sciences.) Summer term III. 6 units. *Gutknecht and staff*

216. Contractile Processes. Cellular and molecular bases of activity in cilia and skeletal, cardiac, and smooth muscle; submicroscopic structure and behavior of muscle; electrical and ionic properties of muscle membranes; the problem of electro-mechanical coupling; mechanics and thermodynamics of muscular contraction; biochemical energetics of contraction; modern methods and problems in contractility research. Alternate years, beginning fall 1979. Prerequisite: physical chemistry recommended but not required. (Also listed as Anatomy 215.) 3 units. *Jöbsis, Johnson, and Anderson*

217. Membrane Transport. Chemical composition and ultrastructure of biological membranes, ionic and osmotic equilibria across the membranes of individual cells, passive and active ionic transport, the role of ATPase, carrier-mediated diffusion of nonelectrolytes, integration of transport processes to produce molecular movements across organized epithelia, e.g. amphibian skin and bladder, and gastrointestinal mucosa. Prerequisite: consent of instructor. Alternate years, beginning fall, 1979. 3 units. *Lauf, Mandel, and Simon*

221. Electrophysiological Techniques. Instruction and practice with emphasis on intracellular recording and stimulating techniques. Topics include: fabrication and use of microelectrodes, electronic instrumentation, voltage clamping, microiontophoretic techniques, as well as bioelectric data processing and modeling. Format will include lectures and demonstrations, but the main effort will be devoted to practice work in the laboratory. Prerequisites: Biomedical Engineering 101 or Physiology 225, or permission of instructor. Offered during summer term I. (Also listed as Biomedical Engineering 221.) 3 units. *Wachtel and staff*

230. Molecular and Cellular Bases of Development. See course description for Anatomy 219. (Also listed as Biochemistry 219, Microbiology 219, and Pathology 219.) Fall. 3 units. *Padilla and staff*

230S. Seminar. Optional seminar offered in conjunction with Physiology 230. 1 unit. *Staff*

240. Seminars in Physiology. Current topics in physiology will be discussed by staff and visiting faculty. Fall and spring. 1 unit. *Padilla*

260. Cell Growth and Differentiation. Lectures and discussions based on an extensive literature survey on the regulation of growth and the cell cycle of eukaryotic cells. Emphasis is on the mechanisms which underlie cellular proliferation, cell renewal, and the functionality of subcellular organelles. Spring only. 3 units. *Padilla and Jakoi*

270. Neurobiology 1. Interdisciplinary approach to neuronal function at the cellular and molecular levels. Topics will include: subcellular structural organization, physiology and pharmacology of excitable membranes, impulse generation and conduction, neurotransmitters, proteins, pre- and post-synaptic organization and function. 3 units. *J. W. Moore, coordinator; Kirshner, Robertson, and Mendell*

271. Neurobiology 2. An integrated view of the central nervous system, taught by members of the Departments of Anatomy, Pharmacology, Physiology, and Psychology. Sensory systems; motor system; sleep and alerting; transmitters and behavior; pathologic discharges; evolutionary and comparative aspects. 3 units. *Somjen and staff*

280. Student Seminar in Physiology. Preparation and presentation of seminars to students and faculty on topics of broad interest to physiology. Required of all physiology students. Fall and spring. 2 units. *Padilla and staff*

281. Teaching in Physiology. Participation with departmental staff in various teaching modes. Lectures, conferences, tutorials, and preparation of self-instructional teaching materials. Required of graduate students in the Department of Physiology. Fall, spring, and summer terms. Credit to be arranged. *Staff*

For Graduates

301. Oxygen Physiological Function. The interrelations between oxidative metabolism and cell organ function will be explored in lectures and demonstrations. The control systems for oxygen utilization at the mitochondrial level as well as the controls for oxygen delivery to the tissue will be emphasized. Questions concerning organ function and dysfunction on the hyperoxic to anoxic axis and the effects of oligemia and ischemia will be discussed as examples of forcing functions. Prerequisite: Physiology 200 or 204 (or equivalent with approval of instructor). 3 units. *Jöbsis and staff*

320. Gastrointestinal Physiology. The normal physiology, mechanisms of control, and transport characteristics of the human gastrointestinal tract and its associated glands (salivary, pancreas, liver) are presented through a series of lectures, problems, and demonstrations. The mechanisms of secretion and reabsorption are treated at a cellular level. Problems focus on quantitation of gastrointestinal function. Spring. 3 units. *Jones, Anderson, and Mandel*

321. Renal Physiology. Basic renal mechanisms involved in the elaboration of urine including concentrating and diluting mechanisms, hemodynamics, and regulation of acid-base balance. Both basic physiological processes and pathophysiological alterations will be considered. Spring. 3 units. *Yarger, Dennis, Harris, and Mandel*

362. Cardiac Muscle Physiology. Selected topics in the physiology of cardiac muscle, including general and comparative morphology and ultrastructure, cardiac electrophysiology and mechanics, and excitation-contracting coupling. Alternate years beginning Spring 1979. 2 units. *Johnson*

372. Research in Physiology. Laboratory investigation in various areas of physiology. Fall and spring. Credit to be arranged. *Staff*

383. Physiological Instrumentation. Electronic methods of measurement of physiological variables. The operational amplifier is used as the active building block in appropriate feedback circuits containing only passive elements to make a wide range of linear instruments including analog computers. Digital logic and computing elements are also developed. Alternate years, beginning spring, 1980. 3 units. *Moore or staff*

401. Metabolic Physiology. The control of gluconeogenesis, protein degradation, the storage and mobilization of glycogen and of lipids will be examined both at the cellular level (e.g. metabolic compartmentation, futile cycling, enzyme modification) and in terms of interactions between tissues such as liver, kidney, and muscle. Strategies for metabolic adaptation to exercise, cold environment, starvation, obesity, and birth will be discussed. Prerequisites: Physiology 204 and one year of biochemistry. Alternate years beginning fall 1977. 3 units. *Blum*

416. Biophysics of Excitable Membranes. Advanced quantitative approach to bioelectric membrane phenomena. Topics include the cable properties of axons, voltage clamping theory and techniques, the ionic mechanisms of excitation, long-term changes in excitability, mechanisms of synaptic transmission, receptor mechanisms, models of membranes and neurons, and some pharmacology of excitable membranes. Prerequisite: A background in calculus, physics, and physical chemistry is recommended. Alternate years beginning fall, 1977. 3 units. *Moore, Wolbarsht, and Ramön*

417. Cellular Endocrinology. Current concepts of the mechanisms of action of hormones at the cellular level, including hormone-receptor interactions; secondary messenger; regulation of protein synthesis; growth and differentiation; control of salt and water balance; regulation of substrate storage and mobilization; modulation of hormone secretion. (Also listed as Pharmacology 417.) Fall. 2 units. *Lebovitz*

418. Reproductive Biology. An in-depth survey of male and female reproductive processes including neuroendocrine, pituitary and gonadal control mechanisms, as well as the physiology of pregnancy and parturition. The basic lecture material in each section of the course is followed by seminar presentations by students and guest clinical faculty with emphasis on the interface between basic and clinical aspects. Spring. (Also listed as Anatomy 418.) 2 units. *Anderson, Schomberg, and Tyrey*

419. Topics in Mathematical Physiology. Microcirculatory models, biological wave propagation, and dimensional analysis and scaling. Prerequisite: consent of instructor. Alternate years beginning spring 1979. 3 units. *Blum, Moore, and Evans*

420. Cellular Immunophysiology. The interaction of antibodies or plant agglutinins with membrane surfaces and the resulting effects on membrane function and cell physiology. Emphasis on permeability changes in red blood cells and certain nucleated mammalian cells mediated by immune reactions as well as on antibody induced alterations of enzyme activities. Prerequisites: Physiology 204 and 217. (Also listed as Microbiology 420.) Alternate years, beginning spring, 1980. 2 units. *Lauf*

Political Science

Professor Holsti, *Chairman* (214) Perkins); Professor Hall, *Director of Graduate Studies* (308 Perkins); Professors Barber, Braibanti, Cleaveland, Grzybowski, Hallowell,

Holsti, Hough, Kornberg, and Leach; Associate Professors Eldridge, Fish, Hawley, Paletz, Price, Rogowski, Salamon, Spragens, and Valenzuela; Assistant Professors Falcone, Kruzel, and McKean; Lecturer O'Barr

The Department of Political Science offers graduate work leading to the A.M. and Ph.D. degrees. Before being admitted to candidacy for the Ph.D. degree, an applicant is normally expected to have qualified for the A.M. degree.

Instruction is designed to prepare the student for teaching and research, for government service, and for other work related to public affairs. Before undertaking graduate study in political science, a student is ordinarily expected to have completed at least 12 semester hours of course work in political science, including some work in American government. Instruction is currently offered in the following fields: American government and politics, comparative government and politics, political theory, international relations, and empirical theory and methodology.

The candidate for the degree of Doctor of Philosophy in political science must take at least twelve courses in the department and demonstrate competence in at least two general fields of the discipline as well as in a third general field or in a specialized subfield or in a field external to the department. The candidate must also demonstrate a reading knowledge of two foreign languages or must demonstrate proficiency in one such foreign language and in the use of statistics.

Further details on the graduate program in political science, the departmental facilities, the staff, and available financial aid may be obtained from the Director of Graduate Studies, Department of Political Science.

For Seniors and Graduates

201. Arms Control and Defense Strategy. Influences on national and international security. Prerequisite: one course in international relations or American foreign policy. 3 units. *Kruzel*

204. Ethics in Political Life. Ethical issues arising in the conduct of political vocations and activities. (Also listed as Public Policy Sciences 204.) 3 units. *Spragens*

206. Politics and the Media. The relationship between the media of mass communication and the American political process. Open to upperclassmen with consent of instructor. 3 units. *Paletz*

207. American Constitutional Interpretation. Development of the constitution of the United States through Supreme Court decisions. Prerequisite: Political Science 127. 3 units. *Fish*

209. Problems in State Government and Politics. 3 units. *Leach*

210. The Politics of Education. The forces in local, state, and national politics which impinge on educational policy-making and administration. Not open to students who have had Political Science 313. (Also listed as Education 210.) 3 units. *Leach*

211S. Current Problems and Issues in Japanese Politics. Sources of strength and weakness in the Japanese economy, the rise of new issues and strains in post-industrial society, changes in the party system and decision-making process, the possible transfer of power, the challenge of Japan's new world role. 3 units. *McKean*

212. Japanese Foreign Policy. Transition from militarism to pacifism in Japan's international posture; the American alliance, rearmament and nuclear weapons, foreign trade and economic foreign policy, and energy and resource politics. 3 units. *McKean*

215. Comparative Legislative Processes. Analysis of the structures and functions of legislative institutions and of the behavior of legislative elites in both parliamentary and congressional systems. 3 units. *Staff*

216S. Comparative Politics of the Welfare State. Analysis of the political processes that shape very different solutions of similar social problems in advanced industrial nations. Examination of the development of income-maintenance programs and health care systems, with some discussion of other social policies. (Also listed as Public Policy Sciences 216S.) 3 units. *Staff*

217S. Economic Theories of Political Behavior. Analysis of economic theories and other formal techniques applied to problems of voting behavior, legitimacy, and constitutional choice, and to strategies of political conflict and coalition. 3 units. *Rogowski*

218S-219S. Political Thought in the United States. Writings of leading political theorists. First semester: founding fathers and their European and Puritan antecedents; the abolitionists and Calhoun. Second semester: progressive period and recurrent themes of contemporary protest and debate. 6 units. *Price*

220S. Problems in International Politics. Prerequisite: one course on international relations, foreign policy, or diplomatic history. 3 units. *Holsti*

221. International Organization. The functioning of the United Nations system and of regional organizations operating in the political and security fields. 3 units. *Staff*

222. Empirical Theory. Critical examination of contemporary, nonnormative conceptual frameworks for political inquiry, with emphasis on the qualifications of these frameworks as theories. 3 units. *Staff*

223. Political Philosophy from Plato to Machiavelli. Intensive analysis of the political philosophies of Plato and Aristotle, a survey of medieval political thought and an analysis of the significance of Machiavelli. 3 units. *Hallowell*

224. Modern Political Theory. An historical survey and philosophical analysis of political theory from the beginning of the seventeenth to the middle of the nineteenth century. Attention is given to the rise of liberalism, the Age of Enlightenment, the romantic and conservative reaction, idealism, and utilitarianism. 3 units. *Hallowell*

225. Comparative Government and Politics: Western Europe. Rise of modern political parties; extension of the suffrage; entry of bourgeoisie, peasants, and workers into politics; center-periphery conflicts; emergence of the welfare state and of planned economies; problems of "collectivist" politics. 3 units. *Rogowski*

226. Theories of International Relations. Contemporary theories of international relations and foreign policy. Emphasis on the interdependence of theory and empirical research. 3 units. *Eldridge*

227. International Law. Elements of international law, particularly as interpreted and applied by the United States; rights and duties of states with respect to recognition, state territory and jurisdiction, nationality, diplomatic and consular relations, treaties, treatment of aliens, pacific settlement of disputes, international regulation of the use of force, and collective responsibility. 3 units. *Grzybowski*

229. Recent and Contemporary Political Theory. The rise of positivism and its impact upon modern political thought, the origins of socialism, Marxism and its variants, socialism in the Soviet Union, nationalism, fascism and national social-

ism, the crisis in modern democracy, Christianity and the social order. 3 units. *Hallowell*

230. American National Government. Formation and contemporary operation of the national political system; historical and behavioral approaches. 3 units. *Staff*

231. American Political Theory. An analysis of the main currents in American political thought from colonial beginnings to the present day, with emphasis upon the development of liberalism in America. 3 units. *Leach*

233. Research Methodology. Measurement, causal analysis, and comparison of different levels of analysis, and other problems in political research. 3 units. *Staff*

234S. Political Economy of Development: Theories of Change in the Third World. Alternative approaches to political, economic, and social change in Latin America, Africa, and Asia. (Also listed as Anthropology 234S, History 234S, and Sociology 234S.) 3 units. *Bergquist, Valenzuela, Pessar, Portes, and Smith*

235. The Commonwealth. Analysis of political relationships among the members of the Commonwealth countries, with emphasis on Canada. 3 units. *Staff*

236. Statistical Analysis. Introduction to statistics in political research, emphasizing inferential statistics through simple regression and correlation. (Not open to students who have had or who are enrolled in Political Science 138, Psychology 117, Mathematics 53 or 183, Management Science 110, or Economics 138.) 3 units. *Staff*

238. Comparative Foreign Policy. An application of comparative theory to the foreign policy decision-making processes of major, middle range, and developing states. 3 units. *Eldridge*

239S. Current Problems of International Law. Theoretical trends, use of sources for research, role of international law in diplomacy and legal practice. For seniors and graduates only. 3 units. *Grzybowski*

241. Public Administrative Organization and Management. The American administrative process: theory and practice of administrative organization and management. 3 units. *Hall*

243. Applications of Administrative and Organizational Theory. Behavioral analysis of public organizations with emphasis on the impact of organizational structures, individual needs and motivation, and politics on the formulation and implementation of public policy. (Also listed as Public Policy Studies 224.) 3 units. *Hawley*

244. Administrative Law and Process. The nature and law of the administrative process in the context of American government and politics, with special attention to the powers, procedures, and judicial control of administrative agencies. 3 units. *Hall*

245S. Ethics and Policy Making. (Also listed as Public Policy Sciences 223S.) 3 units. *Price*

246. Administration and Public Policy. The role of administration in the American policy process. 3 units. *Hall*

247. Political Participation and Policy Outcomes. Impact of citizen participation upon governmental decision making. Theoretical issues and empirical

evidence (primarily American, but partly comparative). (Also listed as Public Policy Sciences 247.) 3 units. *Hough*

248. The Politics of the Policy Process. (Also listed as Public Policy Sciences 219.) 3 units. *McConahay and Blaydon*

249. Comparative International Development and Technology Flow. Theoretical analysis of social, political, and economic development in Third World countries. The internal problem of maintaining political systems and the external problem of adapting intermediate or appropriate technologies. 3 units. *Braibanti*

250. Comparative Government and Politics: Southern Asia. The political development of India and Pakistan. Contextual determinants of the political systems. Political consequences of partition. National integration, constitutional, and institutional aspects of the political systems. Impact of foreign technical assistance. 3 units. *Braibanti*

252. Comparative Political Behavior and Socialization. Elites and mass publics in a variety of Western and non-Western societies including the United States; models of the political socialization process and their implications for democratic theory. 3 units. *Staff*

253. Comparative Government and the Study of Latin America. Current literature on major themes of Latin American politics. 3 units. *Valenzuela*

257S, 258S. Modern East Asia. Introduction to Problems and Literature. 3 units each semester. *McKean*

260. The Tradition of Political Inquiry. Past and present problems, goals, presuppositions, and methods. 3 units. *Spragens*

273S. The American South as a "Developing Society." The concept of modernization as a tool of social and political analysis, and its applicability in explaining the patterns of political and economic evolution in the American South. 3 units. *Salamon*

274. Political Psychology. Psychological theories on political attitudes and opinions ranging from those of Fechner, von Helmholtz, Thurstone, and Likert to the more recent work of Festinger, Bem, McGuire, Converse, Lane, and the functionalists. 3 units. *McConahay*

275. The American Party System. An intensive examination of selected facets of American national political parties, such as relationships between presidential and congressional politics, the politics of national conventions, recent foreign policy and party alignments, and the controversy over party government. 3 units. *Kornberg*

277. Comparative Party Politics. The impact of social and political systems on party structures, functions, ideologies, and leadership recruitment. Emphasis upon research techniques and objectives. 3 units. *Kornberg*

278. Canadian Political Behavior in the North American Context. Institutional processes and political behavior in Canadian and American societies. Impact of multi-partyism, federalism, political and cultural particularism, and the elite structure. 3 units. *Kornberg*

280. Comparative Government and Politics: Sub-Saharan Africa. Politics and government in selected African states, with particular attention to the problems of decolonization and modernization in the post-independence period. 3 units. *Johns*

282S. Seminar on Canada. See course description for History 282S. (Also listed as Anthropology 282S, Economics 282S, and Sociology 282S.) 3 units. *Staff and visitors*

283S. Congressional Policy Making. Lawmaking and oversight of the bureaucracy by the United States Congress. Committee roles, impact of the executive and other external forces. (Also listed as Public Policy Sciences 283S.) 3 units. *Price*

285. The Judicial Process. A study of judicial decision making in the United States, with emphasis on the process of litigation, the recruitment of judges, the influences and limits on judicial decisions, and their impact within the political system. Prerequisite: Political Science 127 or 207, or equivalent. 3 units. *Fish*

291. Problems of Urban Government. 3 units. *Leach*

293. Federalism. Theoretical and operational aspects of federal systems of government, focusing on the United States and Canada. 3 units. *Leach*

For Graduates

301. Teaching Political Science. Examination of the art and craft of teaching political science, including philosophy and purposes of education, nature and function of universities, students, teaching content, and course structures and methodologies. 3 units. *Paletz*

303. Seminar on Selected Topics in Statistics. Introduction to the assumptions and uses of selected multivariate statistics and research methodologies including least-squares analysis, scaling techniques, factor analysis, causal inference, model-building, and computer simulation. Prerequisite: Political Science 236 or consent of instructor. 3 units. *Harf*

306. Seminar in Politics and the Mass Media of Communication. Prerequisite: Political Science 206 or consent of instructor. 3 units. *Paletz*

307. Graduate Seminar in American Voting Behavior. Focus on contemporary and original research in American voting behavior. 3 units. *Staff*

308. Individual Research in Political Science. Students will conduct research designed to evaluate hypotheses of their choice. Reports on the research must be presented in adequate professional style. 3 units. *Staff*

309. Seminar in International Relations. Critical survey of theories and research in international relations and foreign policy. Emphasis will be placed on the interrelation between theory and research. 3 units. *Holsti*

310. Seminar in State and Local Government. Prerequisites: Political Science 209 and 291, or equivalents. 3 units. *Leach*

312. Seminar in Constitutional Law. Prerequisite: Political Science 207 or equivalent. 3 units. *Fish*

313. Education and Public Policy. (Also listed as Education 313.) Not open to students who have had Political Science 210. 3 units. *Leach and Pittillo*

321. Seminar in Political Theory. Prerequisites: 6 units in political science elected from 223, 224, 229, 231, or their equivalents. 3 units. *Hallowell*

322. Seminar in Selected Topics in Empirical and Formal Theory. The empirical and formal treatment of concepts such as power, support, rationality, and collective choice. Prerequisite: Political Science 222 or 233, or consent of instructor. 3 units. *Staff*

323. Seminar in Modern Political Theory. Prerequisites: two 200-level courses in political theory or consent of instructor. 3 units. *Spragens*

325. Seminar in Comparative Government and Politics. 3 units. *Rogowski*

329. Seminar in International Regional Organization. Prerequisite: Political Science 221 or equivalent. 3 units. *Staff*

330. Seminar in Comparative Government and Politics—Southern Asia. Emphasis on research using documentary materials relating to India, Pakistan, Ceylon, and Malaysia. Prerequisite: Political Science 250 or equivalent. *Braibanti*

331. Seminar in American Political Thought. 3 units. *Leach*

340. Seminar in American Politics and Institutions. Survey, analysis, and critique of the literature. 3 units. *Paletz*

341. Seminar in Public Administration. Selected topics in administrative and organizational theory and behavior. Prerequisite: Political Science 141 or 243. 3 units. *Staff*

342. Seminar in American National Government and Politics. Prerequisite: Political Science 230 or equivalent. 3 units. *Barber*

343. Seminar in the Policy Process. Selected topics covering the theory, methodology, and practice of policy formation in American politics. Prerequisite: Political Science 246 or equivalent. 3 units. *Staff*

344. Workshop on Computer Models of Social Systems. (Also listed as Computer Science 344, Economics 344, and Sociology 344.) 3 units. *Naylor*

360. Seminar in Government and Politics in the Soviet Union. Prerequisite: Political Science 165 or consent of instructor. 3 units. *Hough*

361. Seminar in Foreign Relations of the Soviet Union. Prerequisite: Political Science 220S or 360, or consent of instructor. 3 units. *Hough*

376. Seminar in Comparative Political Behavior. An intensive comparative examination of the impact of selected political institutions on political behavior. 3 units. *Kornberg*

380. Seminar in African Government and Politics. Prerequisite: Political Science 280 or equivalent. 3 units. *Johns*

381. Research Seminar in Latin American Government and Politics. Prerequisite: Political Science 253 or equivalent. 3 units. *Valenzuela*

382. Soviet Law and Society. 2 units. *Grzybowski*

401. Seminar in the Commonwealth. 3 units. *Members of the Committee on Commonwealth Studies*

402. Interdisciplinary Seminar in the History of the Social Sciences. A survey of the theories, methods, and tools applied to problems in the history of the social sciences. 3 units. *Goodwin, Holley, and Spragens*

Related Course Work in the School of Law

There may be graduate credit for course work completed in the Duke University School of Law, under regulations referred to in this bulletin under Academic Regulations.

Psychology

Professor Kimble, *Chairman* (224 Psychology-Sociology); Professor Staddon, *Director of Graduate Studies* (242 Psychology-Sociology); Professors Alexander, Bevan, Borstelmann, Carson, Diamond, C. Erickson, R. Erickson, Guttman, Lakin, Lockhead, H. Schiffman, M. Wallach, and Wing; Associate Professors Coie, Costanzo, Day, Hall, and McConahay; Assistant Professors Butzin, Casseday, Eckerman, Kremen, Roth, Rubin, and Wilson; Lecturers Boudewyns, Brodie, Crovitz, Gentry, Marsh, Oppenheim, S. Schiffman, Somjen, L. Wallach, and Wolbarsht; Instructor Buckingham

The department offers work leading to the Ph.D. degree. The areas of concentration are experimental, biological, cognitive, social, personality, developmental, and clinical psychology. Students in experimental, biological, and cognitive psychology should have a strong undergraduate background in the basic sciences: mathematics, physics, biology, and chemistry.

A brochure is available from the Director of Graduate Studies which describes the program in more detail and gives information on financial assistance, facilities, and current research activity.

For Seniors and Graduates

203. Sensation and Perception. Examination of classical and current concepts and methods. 3 units. *Lockhead*

210. Cognitive Psychology. Theoretical and experimental approaches to understanding cognitive processes such as attention, memory, language, problem solving, and thinking. 3 units. *Day, Lockhead, or Rubin*

211. Human Thinking. Literature, classical and modern; data and theories relating to problem solving and decision making, analytical thought, and creative imagination. 3 units. *Bevan*

212. Human Memory. Literature, classical and modern; data and theories relating to mechanisms of information processing, storage, and retrieval. 3 units. *Bevan*

213. Adaptive Behavior. Principles of adaptive behavior in animals. Development, orientation mechanisms, agonistic behavior, communication, habituation and conditioning, and learning mechanisms. 3 units. *Staddon*

214. Development of Social Interaction. Major developments of children's interactions with others (e.g., attachment, social play, aggression, sex-typing, and moral reasoning). Ethological, learning, personality, and cognitive-developmental viewpoints. 3 units. *Eckerman*

215. Cognitive Development. Major concepts of the development of knowledge in children with particular attention to Piaget. Consideration of educational implications. 3 units. *L. Wallach*

216. Biological Psychology. The neural basis of behavior with special emphasis on the organization and evolution of the neocortex and the dorsal thalamus. An historical approach is taken using original texts by LeGros Clark, Elliot Smith, Herrick, Sherrington, Cajal, Campbell and many others. While emphasis is on the neocortical sensory systems, the structure and function of the limbic system and hypothalamus are reviewed. (Also listed as Anatomy 216.) 3 units. *Diamond*

217. Social Psychology. Social factors in cognition, models of social interaction, conformity and social influence, and attitude development and change. 3 units. *Levy*

218. Research Methods in Social Psychology. Emphasis on the interplay between experimental design and technique. 3 units. *Levy*

219. Neural Bases of Behavior. Structure and function of the nervous system as related to problems of sensory-motor processes, learning, and memory. 3 units. *R. Erickson*

230. Social Behavior of Animals. Developmental, ecological, and physiological aspects of territorial, sexual, parental, and aggressive behavior. 3 units. *C. Erickson*

232. Group Processes and Group Development. Group clinical processes and developmental social processes. Readings and field observations in group behaviors ranging from those of toddlers to the elderly. Prerequisite: consent of instructor. 3 units. *Lakin*

234. Seminar in Personality. Selected topics of current interest concerning empirical research on personality. Strategies for the definition of research questions and the evaluation of research progress. 3 units. *M. Wallach*

238S. Electroencephalogram and Psychological Function. A survey of experimental and clinical literature on brain wave correlates of intelligence, personality, behavior disorders, epilepsy, sleep, sensory stimulation, reaction time, and attention. Emphasis on the electrophysiology of conditioning and learning. Lectures, laboratory demonstrations, and clinical case presentations. 3 units. *Marsh*

245. Personality Theory. Representative theories of human functioning, from Freud to contemporary approaches. 3 units. *Staff*

253. Psychological Approaches to Public Policy Analysis. (Also listed as Public Policy Sciences 253.) 3 units. *McConahay*

260. Science, Technology, and Society. Science as a social phenomenon. Relations of science to technology and their articulation through public policy. Interaction of the institutions of science with other societal institutions. (Also listed as Sociology 260.) 3 units. *McKinney and Bevan*

261. Science, Politics, and Government. The structure and values of the scientific community, the mechanism and strategies of government, and their mutual interdependence in American society. (Also listed as Public Policy Sciences 255 and Sociology 261.) 3 units. *Bevan and McKinney*

271S. Selected Problems. 3 units. *Staff*

273, 274. Statistical Principles in Experimental Design. The problems of scientific inference; methods of data analysis and issues in experimental design. 3 units each semester. *Roth*

277. Neuroanatomical Basis of Behavior. Basic neuroanatomy and its physiologic and functional correlates. Prerequisite: consent of instructor. (Also listed as Anatomy 299.) 3 units. *Hall*

283, 284. The History of Psychology. First semester: Aristotle to Kant; second semester: development of modern psychology. Prerequisite for 284: Psychology 283 or consent of instructor. 3 units each semester. *Guttman*

286S. Psychophysiology of Hearing. Relation of anatomy and physiology to psychophysics of the auditory system. Prerequisite: consent of instructor. 3 units. *Casseday*

For Graduates

305. Psychopathology. An examination of behavior disorders, with particular emphasis on explanatory concepts and the evidence from research in this field. 3 units. *Staff*

306. Seminar in Developmental Psychology. Selected topics in cognitive, emotional, and social development. 3 units. *Staff*

307. Introduction to Methods in Psychotherapy. Current trends in psychotherapeutic practice and research. Application of principles drawn from theories of personality to individual and group psychotherapy. 3 units. *Carson or Lakin*

309. Seminar in Learning. Selected topics in operant conditioning and discrimination learning. 3 units. *Staddon*

310. Seminar in Perception. 3 units. *Lockhead*

314. Seminar in Instrumental Behavior. 3 units. *Staff*

317. Seminar in Social Behavior. 3 units. *Staff*

319-320. Research Apprenticeship I. Individualized research training with a faculty mentor. 6 units. *Staff*

325. Seminar in Animal Behavior. Selected topics in the reproductive behavior of animals. 3 units. *C. Erickson*

329-330. Pro-Seminar in Psychology. An intensive examination of original sources in experimental and biological psychology. Ordinarily taken by all students in the natural-science division in their first year of residence. 6 units. *Staff*

331-332. Research Apprenticeship II. Individualized research training with a faculty mentor. 6 units. *Staff*

333, 334. Seminar: Behavioral Studies of the Brain. Selected topics in the neural bases of behavior. 3 units each semester. *R. Erickson and Norton*

335-336. Clinical Inquiry I. Introduction to the process of the assessment of persons, including the study of personal documents, interview data, objective and projective test material, naturalistic observations, and third-party reports. Laboratory sessions involve work with normal human subjects over extended time periods. 6 units. *Alexander and staff*

337. Seminar in Sensory Discrimination. The neural bases of discrimination in vertebrates and invertebrates is studied by neurophysiological, electrophysiological, and psychophysical techniques. 3 units. *R. Erickson*

338. Pictorial Representation and Iconic Communication. A study, through a critical examination of the original literature, of the communication of information by means of pictures, drawings, and other graphic displays in contrast to languages or mathematical symbols. 3 units. *Bevan*

340. Group Processes and Group Therapy. 3 units. *Lakin*

343-344. Clinical Inquiry II. Intensive experience and supervision in clinical intervention processes. Student training in psychotherapy strategies and tech-

niques and in clinical consultation skills is conducted in clinical settings. 6 units.
Staff

350. Practicum in Psychological Research. Ordinarily taken by all students in the natural-science division in their first semester of residence. 3 units.
Staff

Public Policy Sciences

Professor Fleishman, *Director*; Associate Professor McConahay, *Associate Director*; Assistant Professor Cook, *Director of Graduate Studies*; Bonnie Bain, *Director of Internship Programs and Placement Services*; Professors Hough (political science), and Lange (law); Associate Professors Behn, Blaydon, DeVries, Friedman, Ginsburg, Goodwyn (history), Grabowski (economics), Hawley, Murray, Price, Salamon, and Stack; Assistant Professors Decker, Eaker (business), Lipscomb, Nagin, and Vaupel; Lecturers Broder, Eagles, Green, Harris, Hochschild, Payne, Ross, and Zalkind; Visiting Professors Coles and Wallace; Adjunct Professor Hamburg

The graduate program in public policy sciences is offered through the Institute of Policy Sciences and Public Affairs. The objective of the program is to prepare students for public sector jobs which require analytical skills and a practical understanding of the processes by which policy is made and implemented.

The A.M. degree requires two academic years and a summer internship. The first year is devoted to core courses in policy analysis, including sequences in quantitative methods, economics, political analysis, and ethics. The summer internship is arranged with a federal or state agency. The second year curriculum includes course work in public management, a concentration in a substantive policy area, and a masters paper to be researched and written on a problem of current policy concern.

Students who are concurrently enrolled in a Ph.D. program or a professional degree program (M.D., J.D., M.B.A., M.H.A., etc.) or who have already obtained such a degree, can apply for an abbreviated version of the A.M. program. Such students are excused from all the requirements of the second year except for the masters paper, so ordinarily completing the A.M. requirements adds only one year to their graduate programs. Students usually apply for a joint degree program simultaneously with their applications to the graduate departments or professional schools, or during their first or second year of advanced study.

The institute does not award a Ph.D.

More information concerning the A.M. programs can be obtained by writing the Director of Graduate Studies.

For Seniors and Graduates

204. Ethics in Political Life. (Also listed as Political Science 204.) 3 units.
Spragens

215S. Public Policies to Save Lives. Economic, political, legal, and ethical issues in governmental efforts to reduce mortality through various health and safety programs and regulations. 3 units. *Vaupel and Cook*

216S. Comparative Politics of the Welfare State. (Also listed as Political Science 216S.) 3 units. *Staff*

217. Microeconomics and Public Policy Making. Consumption and production theory, welfare economics, theories of collective choice, market structures and regulation, and nonmarket decision making. 3 units. *Staff*

219. The Politics of the Policy Process. The formulation of public policy making, substantive policies in a variety of contexts from local government to

international affairs; the role of legislatures, interest groups, chief executives, and the bureaucracy in defining alternatives and in shaping policy from agenda formulation to implementation. (Also listed as Political Science 248.) 3 units. *Staff*

221. Analytical Methods I: Decision Analysis for Public Policy Makers. Methods for structuring decision dilemmas and decomposing complex problems, assessing the probabilities of uncertain consequences of alternative decisions, appraising the decision maker's preferences for these consequences and for re-examining the decision. (Not open to students who have taken Public Policy Studies 55.) 3 units. *Staff*

222. Analytical Methods II: Data Analysis for Public Policy Makers. Sampling theory, Bayesian statistics, and regression analysis. Examples from problems in health care, transportation, crime, urban affairs, and politics. (Not open to students who have taken Public Policy Studies 112.) 3 units. *Staff*

223S. Ethics and Policy Making. Normative concepts in politics—liberty, justice, the public interest: historical and philosophical roots; relations to one another and to American political tradition; and implications for domestic policy problems. (Also listed as Political Science 245S.) 3 units. *Price*

224. Applications of Administrative and Organizational Theory. Behavioral analysis of public organizations with emphasis on the impact of organizational structures, individual needs and motivation, and politics on the formulation and implementation of public policy. (Also listed as Political Science 243.) 3 units. *Hawley or Lewicki*

231. Analytical Methods III: Quantitative Policy Evaluation. Problems in quantifying policy target variables such as unemployment crime, and poverty. Experimental and nonexperimental methods for evaluating the effect of public programs, including topics in experimental design, regression analysis, and simulation. Prerequisite: Public Policy Sciences 222 or the equivalent. 3 units. *Staff*

232. Analytical Methods IV: Topics in Economic Policy. Cost benefit analysis of public programs. Public utility regulation, pollution regulation, hospital rate setting, regulation of product safety. Quantitative methods and microeconomic theory for analysis of both normative and positive aspects of economic policy. Prerequisites: Public Policy Studies 110 or 217 or Economics 149 and familiarity with regression analysis or enrollment in Public Policy Studies 231 concurrently. 3 units. *Staff*

233. Analytic Approaches to Bargaining, Cooperation, and Competition. Application of principles of game theory, economics, and psychology to labor-management negotiation, plea bargaining, public interest group formation, corporate collusion, business mergers, and arms limitations. 3 units. *Blaydon*

236S. Public Financial Management. State and local governments. Budgetary requirements and fund raising. 3 units. *Blaydon*

246. Population Policy. (Also listed as Sociology 246.) 3 units. *Back*

247. Political Participation and Policy Outcomes. (Also listed as Political Science 247.) 3 units. *Hough*

250. Public Policy and the Arts. Problems of democratic and aesthetic values in respect to past and present patterns of public support for the arts; for example: subsidies, tax policy, censorship and the effect of public choices on standards of quality. Visual and performing artists and policy makers from government and business will participate. 3 units. *Diamonstein and Payne*

252S. National Security Policy. Analysis of current national security issues from a variety of analytical and historical perspectives. 3 units. *Kuniholm*

253. Psychological Approaches to Public Policy. Contribution of psychological analysis to an understanding of social issues such as poverty, drug abuse, crime, crowding, and race relations, the ways problems are recognized, and why different policy alternatives are selected (e.g., those that "blame the victim"). (Also listed as Psychology 253.) 3 units. *McConahay*

254. Transportation Planning and Policy Analysis. (Also listed as Civil Engineering 216.) Prerequisite or corequisite: Civil Engineering 116 or consent of instructor. 3 units. *Behn or Lathrop*

255. Science, Politics, and Government. The structure and values of the scientific community, the mechanisms and strategies of government, and their mutual interdependence in American society. (Also listed as Psychology 261 and Sociology 261.) 3 units. *McKinney and Bevan*

256. The Economics of Health Care. An examination of the health care industry and government policies. Topics include national health insurance; the relationship between insurance, supply constraints, and inflation; the supply and distribution of health manpower; hospital cost containment policy; and approaches to the "optimal" allocation of health care viewed as a social good. Prerequisite: Economics 149, or equivalent, or consent of instructor. 3 units. *Ginsburg or Lipscomb*

260S. Public Policy Research Seminar: The Administration of Justice. Examination of public policy issues concerning the administration of justice. 3 units. *Cook or Nagin*

261S. Research Seminar: Health Policy. Determinants and impacts of public policies designed to improve the equity and efficiency of health services. The supply and distribution of services; the cost of services and alternative modes of financing; the quality of services and alternative mechanisms of quality control. Applied research paper. 3 units. *Ginsburg and Lipscomb*

262S. Communication Policy and the Law. Theory and development of the First Amendment and its relation to public policies dealing with regulation of the electronic and print media, the rights of privacy and access to information. 3 units. *Lange*

263S. Public Policy Research Seminar: Urban and Regional Development Policy. Dynamics of urban and regional development analyzing alternative policy instruments for coping with the social, environmental, and economic effects. Housing, land use, transportation, taxation, environmental protection, and related urban development problems and policies. Prerequisite: Political Science 176, Political Science 109, Economics 234, or consent of instructor. 3 units. *Salamon*

264S. Public Policy Research Seminar: Topics in Public Policy I. Selected topics. 3 units. *Staff*

265S. Seminar in Selected Public Policy Topics. 3 units. *Staff*

270S. Humanistic Perspectives on Public Policy. Modes of inquiry into aspects of social life important to policy makers but beyond the normal reach of social science. Reading from James Agee, Robert Coles, Eudora Welty, James Baldwin, George Eliot, and others. Prerequisite: consent of instructor. 3 units. *Payne and Coles*

271. The Uses of History in Public Policy: I. Introduction to historical analysis as a technique for formulating and evaluating public policy. (Also listed as History 203.) 3 units. *Goodwyn*

272. Poverty in the United States: An Historical Perspective. Social, political, and cultural origins and contemporary policy alternatives. (Also listed as History 272.) 3 units. *Decker*

273S. The Uses of History in Public Policy II. Introduction to historical analysis as a technique for formulating and evaluating public policy. Emphasis on public policy decisions abroad since World War II, including the structuring of selected contemporary problems in light of their historical contexts. (Also listed as History 204S.) 3 units. *Kuniholm*

274. Mental Health Policy and American Culture. Effect of culture and values on perceptions of mental health among diverse ethnic groups and social classes. Formation and implementation of related public policies. 3 units. *Stack*

275. Class, Ethnicity, and Social Policy. The uses of anthropological modes of analysis for understanding social issues and public policy, with a focus on class, work, ethnicity, sex roles, and the family. (Also listed as Anthropology 277.) 3 units. *Stack*

276S. National Policies and the Family. Effects of public policies on American families, the feasibility of a national family policy, and the parameters of family impact statements. Prerequisite: Public Policy Sciences 171S or consent of instructor. 3 units. *Stack*

283S. Congressional Policy Making. (Also listed as Political Science 283S.) 3 units. *Price*

277. Sex Discrimination and the Law. Legal, social, and familial aspects of sex discrimination. Topics include the Equal Rights Amendment, employment, differential treatment in the criminal law. 3 units. *Stack*

284S. Research Seminar in Communications Policy. Guided research in and analysis of selected areas of communications policy, especially those dealing with regulation of the media and other forms of public expression. 3 units. *Lange*

For Graduates

301. Public Policy Workshops. Individual and group work providing experience in applying the knowledge, theory, and skills being taught in one or more of the core courses in public policy concurrently being taken. Open only to graduate students in public policy. 3 units. *Staff*

302. Public Policy Workshop. Same as 301 with applications to the subject matter of spring semester courses. 3 units. *Staff*

387. Research Tutorial in Public Policy. 3 units. *Staff*

388. Research Tutorial in Public Policy. 3 units. *Staff*

391. Multinational Corporations Seminar. The nature and consequences of multinational corporations. The international economic environment in which multinational corporations operate. The problems of managing a multinational corporation. Public policy toward multinational corporations. (Also listed as Business Administration 391.2.) 3 units. *Vaupel*

399. Special Readings in Public Policy Sciences. 3 units. *Staff*

Religion

Professor Poteat, *Chairman* (117B Gray); Professor M. Smith, *Director of Graduate Studies* (209A Divinity School); Professors Baker, Beach, Bradley, Cushman, Davies, Henry, Herzog, Lacy, Langford, Lincoln, Long, Murphy, Osborn, Price, H. Smith, Steinmetz, Wintermute, and Young; Associate Professors Bailey, Bland, Charlesworth, Corless, Gregg, Kort, Lawrence, Meyers, Partin, Raitt, and Robinson

The Department of Religion offers graduate work leading to the A.M. and Ph.D. degrees. Students may major in one of four fields: (1) Biblical studies; (2) historical studies; (3) systematic and contemporary studies; and (4) history of religions. They will be expected to take such courses in one or more of the other fields which will contribute to an adequate understanding of their chosen fields of specialization.

In addition to course work in these major fields, students will take such other courses in cognate fields as will contribute to the enrichment of their major studies. This minor requirement may be fulfilled either by work in a cognate department, such as classical studies, history, philosophy, political science, or sociology, or by work in a cognate field within the Department of Religion other than the field of major concentration.

The program of doctoral studies presumes a foundation in the academic study of religion. Students applying for graduate work in religion directly from an undergraduate program should have had a strong undergraduate major in religion, and will be accepted for the Ph.D. program only upon the satisfactory completion of the A.M. degree with the department.

FIELD I. BIBLICAL STUDIES

207, 208. Intermediate Biblical Hebrew. Grammar with reading and exegesis of Old Testament prose and poetry. Prerequisite: at least one year of Hebrew or consent of the instructor. (Also listed as Old Testament 207-208 in the Divinity School.) 6 units. *Meyers and Wintermute*

209. Old Testament Theology. Studies of the Old Testament in regard to theological themes and content. 3 units. *Murphy*

220. Rabbinic Hebrew. Interpretive study of late Hebrew, with readings from the Mishnah (Avot and Avodah Zarah). 3 units. *Meyers or staff*

221. Readings in Hebrew Biblical Commentaries. Selected Hebrew texts in Midrash Aggadah and other Hebrew commentaries reflecting major trends of classical Jewish exegesis. 3 units. *Bland*

223A. Exegesis of the Hebrew Old Testament: Amos and Hosea. Interpretation based upon Hebrew exegesis, stress upon hermeneutic methods. 3 units. *Bailey*

223B. Exegesis of the Hebrew Old Testament: Job. 3 units. *Murphy*

223C. Exegesis of the Hebrew Old Testament: Exodus. 3 units. *Bailey*

223D. Exegesis of the Hebrew Old Testament: Song of Songs. 3 units. *Murphy*

223E. Exegesis of the Hebrew Old Testament: Ecclesiastes. 3 units. *Murphy*

225. Living Issues in New Testament Theology. Critical examination of major problems and issues in New Testament interpretation and theology. 3 units. *M. Smith*

226A. Exegesis of the Greek New Testament I (Mark and Matthew). 3 units. *Price or Smith*

226B. Exegesis of the Greek New Testament I (Romans). 3 units. *Price*

226D. Exegesis of the Greek New Testament I (I and II Corinthians). 3 units. *Price and M. Smith*

226E. The Gospel and Epistles of John. Exegesis of the Johannine literature in Greek. 3 units. *M. Smith*

227A. Exegesis of the Greek New Testament II (Luke-Acts). 3 units. *Young*

227B. Exegesis of the Greek and New Testament II (Galatians). 3 units. *M. Smith*

227C. Exegesis of the Greek New Testament II (The Pastoral Epistles). 3 units. *Young*

237. History of the Ancient Near East. Emphasis upon the religions, literature, and art of Mesopotamia. 3 units. *Bailey*

239. Introduction to Middle Egyptian. Grammar and readings in hieroglyphic texts relating to the Old Testament. 3 units. *Wintermute*

242. Life After Death in Semitic Thought. Consideration of the various ideas from the early second millennium through the Intertestamental Period. Exegesis of selected Old Testament passages. Evaluation of recent research. Knowledge of Hebrew helpful but not required. 3 units. *Bailey*

244. The Archaeology of Palestine in Hellenistic-Roman Times. The study of material and epigraphic remains as they relate to Judaism in Hellenistic-Roman times, with special emphasis on Jewish art. Prerequisite: reading knowledge of a Biblical language. 3 units. *Meyers*

258. Coptic. Introduction to the Sahidic dialect with selected readings from Christian and Gnostic texts. Prerequisite: at least one year of Greek. 3 units. *Wintermute*

302. Studies in the Intertestamental Literature. Selected documents of the Apocrypha and Pseudepigrapha examined exegetically and theologically in their relation to postexilic Judaism. Prerequisite: consent of instructor. 3 units. *Charlesworth*

304. Aramaic. A study of the Aramaic portions of the Old Testament and selected passages from the Elephantine and Qumran texts. 3 units. *Meyers or Wintermute*

304A. Targumic Aramaic. An introduction to the language and literature of the Aramaic translations of the Old Testament. 3 units. *Meyers*

306. Language and Literature of the Dead Sea Scrolls. A study in interpretation. Prerequisite: a knowledge of Hebrew. 3 units. *Charlesworth*

307. Syriac. A study of the script and grammar, with readings from the Syriac New Testament and other early Christian documents. Prerequisite: some knowledge of Hebrew and Aramaic. 3 units. *Charlesworth*

311. Pharisaic Judaism in the First Century. A reading course in first-century Pharisaic Judaism. 3 units. *Davies*

312. Pauline Theology. Studies in some aspects of Paulinism in the light of recent scholarship. 3 units. *Davies*

314. Judaism and Christianity in the New Testament. Their interaction with special attention to Paul. 3 units. *Davies*

319. The Gospel According to St. Matthew in Recent Research. 3 units. *Davies*

323A. Comparative Semitic I. An introduction to the morphology and syntax of classical Arabic and the Semitic languages of Mesopotamia, together with a consideration of their relationship to Hebrew. 3 units. *Wintermute*

323B. Comparative Semitic II. An introduction to the morphology and syntax of classical Ethiopic and the Semitic languages of Palestine-Syria, together with a consideration of their relationship to Hebrew. 3 units. *Wintermute*

340-341. Seminar in the New Testament. Research and discussion on a selected problem in the Biblical field. 3 units each semester. *Price, M. Smith, and Young*

345. The Epistle to the Hebrews in Recent Research. Intensive attention to the text and to secondary sources. 3 units. *Davies*

350-351. Old Testament Seminar. Research and discussion on selected problems in the Old Testament and related fields. 3 units each semester. *Murphy*

353. Seminar on Text Criticism. Emphasis upon transmission, versions, apparatus, and method. Prerequisite: reading knowledge of Hebrew and Greek. 3 units. *Bailey*

373-374. Elementary Akkadian. Study of the elements of Akkadian grammar. Reading of neo-Assyrian texts shedding light on the Old Testament. Prerequisite: Biblical Hebrew. 6 units. *Bailey*

375-376. Elementary Ugaritic. Study of the elements of Ugaritic. Prerequisite: Biblical Hebrew. 6 units. *Bailey*

401. Colloquium in Biblical Studies. A colloquium in which all graduate faculty and students in the Biblical division participate. Research papers in the Biblical field are read and discussed.

FIELD II. HISTORICAL STUDIES

204. Origen. The systematic and apologetic writings of an important Alexandrian thinker and exegete of the third century. 3 units. *Gregg*

206. Christian Mysticism in the Middle Ages. Source studies in historical perspectives of such late medieval mystics as Bernard of Clairvaux, the Victorines, Ramon Lull, Meister Eckhart, Richard Rolle, Catherine of Siena, and Nicholas of Cusa. (Also listed under Medieval and Renaissance Studies.) 3 units. *Raitt*

219. Augustine. The religion of the Bishop of Hippo in the setting of late antiquity. (Also listed under Medieval and Renaissance Studies.) 3 units. *Gregg*

236. Luther and the Reformation in Germany. The theology of Martin Luther in the context of competing visions of reform. (Also listed under Medieval and Renaissance Studies.) 3 units. *Steinmetz*

238. Jewish Responses to Christianity. Apologetic and polemical themes in rabbinic, medieval, and contemporary writings. 3 units. *Bland*

241. Problems in Reformation Theology. (Also listed under Medieval and Renaissance Studies.) 3 units. *Steinmetz*

246. Problems in Historical Theology. Prerequisite: consent of instructor. 3 units. *Raitt*

247. Readings in Latin Theological Literature. Critical translation and study of important theological texts in Latin from various periods of the history of the Church. 3 units. *Steinmetz or Raitt*

251. The Counter-Reformation and the Development of Catholic Dogma. Issues in Roman Catholic theology from the Reformation to the Second Vatican Council. (Also listed under Medieval and Renaissance Studies.) 3 units. *Raitt*

252. Nineteenth and Twentieth Century Roman Catholic Theology. An examination of Roman Catholic theology from Vatican I to the present, with special attention to "Modernism" and the work of Vatican II. 3 units. *Raitt*

260. Seminar: Wesley Studies. The lives and thoughts of John and Charles Wesley and their colleagues in relation to English culture and religion in the eighteenth century. 3 units. *Baker*

290. Current Problems in Christian Social Ethics. A critical study of secularization, the technological revolution, and the ecological crisis. 3 units. *Beach*

291. Historical Forms of Protestant Ethics. A survey of major types of Protestant ethical theory from Luther through contemporary figures. 3 units. *Beach*

296. Religion on the American Frontier. A study of the spread of evangelical Christianity as a theological and cultural phenomenon of the American West. 3 units. *Henry*

308. Greek Patristic Texts. Critical translation and study of selected Greek texts illustrative of significant aspects of patristic theology and history from the second through the fifth century A.D. 3 units. *Young*

313. The Apostolic Fathers. A study of the religious thought in the writings of the Apostolic Fathers. 3 units. *Young*

315-316. Seminar: History of Religions. Selected problems in the field. 3 units.

317. Seminar in the Greek Apologists. A study of the apologetic writings of the Greek Fathers in relation to the challenges of their contemporary world. Special attention will be given to leading protagonists of late Graeco-Roman culture, such as Celsus, Porphyry, and Julian, et al. 3 units. *Young*

318. Seminar in the Greek Fathers. A study of selected topics from the Greek Fathers. 3 units. *Young or Gregg*

334. Theology and Reform in the Later Middle Ages. The life and thought of the medieval Church from the twelfth century through the fifteenth. Popular and academic theologians from Pierre Abelard to Gabriel Biel. (Also listed under Medieval and Renaissance Studies.) 3 units. *Steinmetz*

335. The English Church in the Eighteenth Century. Studies of Christianity in England from the Act of Toleration, 1689, to the death of John Wesley, 1791. 3 units. *Baker*

337. Theology of St. Thomas Aquinas. Intensive reading of the *Summa Theologica* and biblical commentaries. 3 units. *Raitt*

338. Calvin and the Reformed Tradition. The theological development of John Calvin. A comprehensive examination of his mature position with constant

reference to the theology of other reformers. (Also listed under Medieval and Renaissance Studies.) 3 units. *Raitt or Steinmetz*

339. The Radical Reformation. Protestant movements of dissent in the sixteenth century. Special attention will be devoted to Muntzer, Carlstadt, Hubmaier, Schwenckfeld, Denck, Marpeck, Socinus, and Menno Simons. (Also listed under Medieval and Renaissance Studies.) 3 units. *Steinmetz*

344. Zwingli and the Origins of Reformed Theology. Source studies in the early Reformed tradition. (Also listed under Medieval and Renaissance Studies.) 3 units. *Steinmetz*

384. Religious Dissent in American Culture. History and significance of dissent in the theology and culture of America. 3 units. *Henry*

385. Religion in American Literature. A critical study of the meaning and value of religious motifs reflected in American literature. 3 units. *Henry*

395. Christian Thought in Colonial America. Exposition of the main currents in Protestant theology. 3 units. *Henry*

396. Liberal Traditions in American Theology. A study of the main types of modern religious thought, beginning with the theology of the Enlightenment. 3 units. *Henry*

FIELD III. SYSTEMATIC AND CONTEMPORARY STUDIES

210. Contemporary British Theology. Selected problems in representative British theological writings after 1900. 3 units. *Langford*

211. Authority in Theology. The idea and function of authority in theology. 3 units. *Langford*

214. The Christian Doctrine of Salvation. A systematic exposition and restatement of the historic faith of the Church in relation to representative secular alternatives of ancient and modern times. 3 units. *Cushman*

230. The Meaning of Religious Language. An analysis of the credentials of some typical claims of theism in the light of theories of meaning in recent thought. (Also listed as Philosophy 230.) 3 units. *Poteat*

231. Seminar in Religion and Contemporary Thought. Analytical reading and discussion of such critical cultural analysis as is found in the works of Polanyi, Arendt, Trilling, and others, with appraisal of the relevance of theological inquiry. 3 units. *Poteat*

232. Methods in Religion and Literature. An examination of various scholarly methods for identifying and addressing issues and problems in religion and literature. 3 units. *Kort*

233. Modern Narratives and Religious Meanings. A study of kinds of religious meaning or significance in representative American, British, and Continental fiction of the first half of the twentieth century. 3 units. *Kort*

245. Ethics in World Religions. Moral foundations, assumptions, and applications in such major faiths as Hinduism, Buddhism, Confucianism, and Islam, in the light of Christian ethical perspectives. 3 units. *Lacy*

248. The Theology of Karl Barth. A historical and critical study of the theology of Karl Barth. Prerequisite: consent of instructor. 3 units. *Osborn*

262. Marxist Ideology and Christian Faith. Comparative examination of Communist and Christian doctrines, such as man, society, sin, history, and

eschatology, together with an introduction to the contemporary dialogue. 3 units. *Lacy*

264. The Sociology of the Black Church. An effort to identify, define, describe, and interpret the Black Church. 3 units. *Lincoln*

265. The Religions of the West Africa Diaspora. Religious development of Africans displaced to the Western Hemisphere by slavery. 3 units. *Lincoln*

281. Phenomenology and Religion. Scheler, E. Strauss, Merleau-Ponty, Ricoeur, Binswanger, or others; their bearing upon religious knowledge and practice. Prerequisite: consent of instructor. 3 units. *Poteat*

300. Systematic Theology. Method and structure of systematic theology, the doctrine of God, theological anthropology, and Christology. 3 units. *Cushman, Herzog, or Langford*

320. Theology, Power, and Justice. Critical examination of a major theme of modern Protestant thought in Hegel, Marx, Schleiermacher, and Tillich. 3 units. *Herzog*

322. Nineteenth-Century European Theology. Protestant theology from Kant to Herrmann. 3 units. *Herzog*

325. Philosophical Theology I. Theology, as the knowledge of God, considered in dialogue with selected pagan and Christian philosophers from Plato to Kant. 3 units. *Cushman*

326. Philosophical Theology II. Continuation of Philosophical Theology I. 3 units. *Cushman*

327. Philosophical Method in Religious Studies. Gadamer, Habermas, and Ricoeur applied to Christian theology in Europe. 3 units. *Herzog*

328. Twentieth-Century European Theology. Critical examination of the thought of selected Protestant theologians from 1900 to 1950. 3 units. *Herzog*

352. Seminar in Christian Theology. Research and discussion of a selected problem in the systematic field. 3 units. *Staff*

360. Special Problems in Religion and Culture. Intensive investigation of the relations of religion and modernity, using seminal contemporary texts. Topics announced each semester. Prerequisite: consent of instructor. 3 units. *Poteat*

361. Language and Biblical Criticism. An attempt to explore the bearing of recent investigators into the nature of language upon problems in the study of Biblical texts. Prerequisite: consent of both instructors. 3 units. *Poteat and Charlesworth*

370. Seminar in Religion and Literature. Analysis and discussion of theories and of individual research projects. 3 units. *Kort*

377. Contemporary American Dramatic Arts and Evolving Theological Forms. An examination of creed and ritual implicit and explicit in contemporary American theater, film, and television. 3 units. *Henry*

380. Existentialist Thought. An exploration of the interests and motifs of existentialism in relation to modern philosophy and theology through an analysis of representative writings of Kierkegaard, Heidegger, Berdyaev, Marcel, and Sartre. 3 units. *Poteat*

383. Moral Theology in the Twentieth Century. Critical and comparative examination of ethical theory as exhibited in the work of selected contemporary theologians. 3 units. *H. Smith*

386. Christianity in Dialogue with Other Faiths. Contemporary currents of Christian thought as they affect resurgent non-Christian faiths, new formulations of a theology of mission, and ecumenical conversations. 3 units. *Lacy*

387. Ethical Method. Selected methodological issues in contemporary theological ethics. 3 units. *H. Smith*

388. Ethics and Medicine. A critical study of selected aspects of modern biomedical technology, with special reference to the ethical assumptions informing their development and practice. 3 units. *H. Smith*

389. Christian Ethics and Contemporary Culture. A study of the interaction between Christian thought and current social theory. 3 units. *Beach*

394. Christianity and the State. The relation of the Christian theory of the state to political problems, with special consideration of the religious assumptions underlying democratic theory and practice and of the relationship of church to state. 3 units. *Beach*

397. Contemporary American Theology. A critical appraisal of major tendencies. 3 units. *Henry*

398. Colloquium on the College and University Teaching of Religion. A consideration of the curricular content and method in the teaching of religion courses. *M. Smith and others*

FIELD IV. HISTORY OF RELIGIONS

217. Islam in India. History and thought of major Indian Muslims from Biruni to Wali-Ullah, with special attention to the role of Sufism. An introduction to selected Muslim scholars and saints who contributed to the interaction between Islam and Hinduism in Northern India during the second millennium A.D. 3 units. *Lawrence*

218. Religion in Japan. A survey of religion in Japan, with special emphasis on indigenization and attempts at synthesis. An approach to the meaning of the words *religious* and *secular* in the Japanese situation. 3 units. *Corless*

254. Introduction to African Religions. An introduction to the religions of the African people. 3 units. *Long*

255. Seminar on African Religions. Selected areas and problems in the religions of African peoples. 3 units. *Long*

280. The History of Religions. A study of the methodology of the history of religions, the nature of religious experience, and specific categories of religious phenomena. 3 units. *Partin*

282. Myth and Ritual. Historical and phenomenological study of myth and ritual in their interrelationships in the history of religions, with particular attention to religious pilgrimage. 3 units. *Partin*

284. The Religion and History of Islam. Origins and development of the Islamic community and tradition, with particular attention to the religious element. 3 units. *Partin*

286. Religious Trends in the Indian Subcontinent. Leaders and movements among the religions of the subcontinent from the coming of the Europeans to Independence. 3 units. *Bradley*

287. The Scriptures of Asia. Translations of basic texts from the religious traditions of India, China, and Japan. 3 units. *Bradley*

288. Buddhist Thought and Practice. A historical introduction to Buddhist thought and practice, with special attention to their interrelationship in the living religion. 3 units. *Corless*

315-316. Seminar: History of Religions. Selected problems in the field. 6 units.

324. Readings in the History of Religion. An examination of the theories, methods, and purposes of the study of non-Western religions within the Western tradition. 3 units. *Long*

Romance Languages

Professor Tetel, *Chairman* (205 Languages); Associate Professor Vincent, *Director of Graduate Studies* (214 Languages); Professors Cordle, Fein, Niess, Osuna, and Wardropper; Associate Professors Garci-Gómez, Hull, and Stewart; Assistant Professor Caserta

The Department of Romance Languages offers graduate work leading to the A.M., M.A.T., and Ph.D. degrees in French and Spanish. Requirements for the A.M. may be completed by submission of a thesis or by passing a comprehensive examination in the major field. It is hoped that candidates for the A.M. and Ph.D. degree will take related work in a second Romance language; however, related work may be taken in any one or two of a number of other subject areas.

In order to undertake graduate study in Romance languages, the entering student should have credit for at least 18 semester hours (or equivalent) above the intermediate level in the major language.

FRENCH

For Seniors and Graduates

210. The Structure of French. Modern French phonology, morphology, and syntax. Readings in current linguistic theory. 3 units. *Hull*

213. French Literature of the Seventeenth Century. The Baroque and the Classical: form and meaning in the plays of Corneille, Racine, and Molière. Readings in baroque and précieuse poetry. (Also listed under Medieval and Renaissance Studies.) 3 units. *Staff*

214. The "Moralistes" of the Seventeenth Century. Rise of modernity. Form and meaning in the works of Descartes, Pascal, La Rochefoucauld, La Fontaine, La Bruyère, Fénelon and Mme de Sévigné. (Also listed under Medieval and Renaissance Studies.) 3 units. *Staff*

217. French Symbolism. The poetry and theories of Baudelaire, Mallarmé, and Rimbaud. Decadence: Lautréamont, and Laforgue. 3 units. *Staff*

219. Old French Literature. An introduction to the reading of Old French literary texts. (Also listed under Medieval and Renaissance Studies.) 3 units. *Vincent*

220. French Pre-Romantic and Romantic Poetry. Chénier, Vigny, Lamartine, Musset, Hugo, and Nerval. 3 units. *Niess*

221, 222. The Nineteenth-Century French Novel. First semester: Romanticism and Romantic Realism, studies especially in the works of Chateaubriand, Stendhal, and Balzac. Second semester: Realism and Naturalism, with special emphasis on Flaubert and Zola. 6 units. *Niess*

224. History of the French Language. The evolution of French from Latin to its present form; internal developments and external influences. (Also listed under Medieval and Renaissance Studies.) 3 units. *Hull*

225. French Prose of the Sixteenth Century. Rabelais, Marguerite de Navarre, Montaigne, and others. (Also listed under Medieval and Renaissance Studies.) 3 units. *Tetel*

226. Topics in Renaissance Poetry. 3 units. *Tetel*

228. French Poetry of the Twentieth Century. In the wake of symbolism; Valéry and Claudel; poetry as ritual, Péguy; Appollinaire and surrealist poetry; the contemporary movement, Michaux, Char, Saint-John Perse. (Also listed under Medieval and Renaissance Studies.) 3 units. *Staff*

233. Contemporary French Theater. A study of dramatic theory; the art of the leading directors; and the major texts of Claudel, Giraudoux, Anouilh, Sartre, Beckett, Ionesco, and Genet. 3 units. *Staff*

234. Proust. A study of *A la recherche du temps perdu*. The thematic structure and the aesthetics of the work. 3 units. *Staff*

241, 242. French Literature of the Eighteenth Century. First semester: the literature of the Enlightenment, including Montesquieu, Voltaire, Diderot, Rousseau, and the *Encyclopédie*. Second semester: the development of literary forms, with emphasis on the theater and the novel. 6 units. *Stewart*

245, 246. French Literature of the Twentieth Century. First semester: to 1935, emphasis on Gide, Mauriac, and Malraux. Second semester: after 1935, emphasis on Sartre, Camus, and the *nouveau roman*. 6 units. *Cordle*

For Graduates

311, 312. French Seminar. Each semester one of the following topics will be selected for intensive treatment: studies in sixteenth-century literature, studies in eighteenth-century literature, studies in nineteenth-century literature, studies in seventeenth-century literature, studies in contemporary literature, studies in medieval literature. (Also listed under Medieval and Renaissance Studies.) 3 units each semester. *Cordle, Niess, Stewart, Tetel, and Vincent*

— **Graduate Reading Course.** An intensive course in French to develop rapidly the ability to read French in several fields. Graduate students only. No credit.

ITALIAN

For Seniors and Graduates

283. Italian Novel of the Novecento. Representative novelists from Svevo to the most recent writers. 3 units. *Caserta*

284. Dante. *La Vita Nuova* and a close reading of the *Inferno*. Conducted in English. (Also listed under Medieval and Renaissance Studies.) 3 units. *Caserta*

285. Dante. The *Purgatorio* and the *Paradiso* in the light of Dante's cultural world. Special attention will be given to the poetic significance of the *Commedia*.

Prerequisite: Italian 284 or equivalent. (Also listed under Medieval and Renaissance Studies.) 3 units. *Caserta*

288. The Renaissance. Petrarch, Boccaccio, and Ariosto. (Also listed under Medieval and Renaissance Studies.) 3 units. *Tetel*

SPANISH

For Seniors and Graduates

251. The Origins of Spanish Prose Fiction. A critical study based on close readings and discussion of selected examples of the principal genres of the romance and the novel: the *Amadís de Gaula*, Diego de San Pedro's *La cárcel de amor*, the *Abencerraje*, the *Lazarillo*, Montemayor's *Diana*. (Also listed under Medieval and Renaissance Studies.) 3 units. *Wardropper*

252. Spanish Lyric Poetry Before 1700. A critical study, based on close reading and discussion, of selected poems of the Middle Ages, Renaissance, and Baroque. Special emphasis on the *Razón de amor*, *la poesía de tipo tradicional*, and Santillana; on Garcilaso, San Juan de la Cruz, Fray Luis de León, and Herrera; on Góngora and Quevedo. (Also listed under Medieval and Renaissance Studies.) 3 units. *Wardropper*

253. The Origins of the Spanish Theater. A study of the evolution of the Spanish theater from *Auto de los Reyes Magos* (twelfth century) through the end of the sixteenth century. The idea of the theater as dramatic poetry will be stressed; close reading of texts by Gómez Manrique, Encina, Gil Vicente, Torres Naharro, Lope de Rueda, Juan de la Cueva. (Also listed under Medieval and Renaissance Studies.) 3 units. *Wardropper*

255, 256. Modern and Contemporary Spanish American Literature. First semester: poetry from *Modernismo* to the present. Second semester: twentieth-century fiction. 3 units. *Fein*

257. History of the Spanish Language. Formation and development of Spanish: internal forces and external contributions. (Also listed under Medieval and Renaissance Studies.) 3 units. *Garci-Gómez*

258. Medieval Literature. An introduction to selected authors and works. (Also listed under Medieval and Renaissance Studies.) 3 units. *Garci-Gómez*

260. Origins and Development of Spanish Romanticism. Representative authors, including Espronceda, Rivas, Zorrilla, Bécquer, and Rosalía de Castro, with a stress on drama and poetry. 3 units. *Staff*

261. Nineteenth-Century Novel. A study of literary trends in the last half of the nineteenth century. Readings will be selected from the novels of Valera, Pereda, Galdós, Pardo Bazán, Blasco Ibáñez, and their contemporaries. 3 units. *Staff*

262. The Theater of Galdós. A selection of his plays. 3 units. *Osuna*

265. Cervantes. The life and works of Cervantes, with special emphasis on his *Quijote*. (Also listed under Medieval and Renaissance Studies.) 3 units. *Wardropper*

266. Drama of the Golden Age. Study of the chief Spanish dramatists of the seventeenth century with readings of representative plays of this period. (Also listed under Medieval and Renaissance Studies.) 3 units. *Wardropper*

270. The Literature of Eighteenth-Century Spain. Cultural, political, social, and historical aspects of the works of Feijoo, Cadalso, Jovellanos, L.F. de Moratín, Meléndez, Valdés, and the fabulists. 3 units. *Osuna*

275. Modern Spanish Poetry. Juan Ramón Jiménez, Unamuno, Antonio Machado, the Generation of 1927, and the contemporary poets. 3 units. *Osuna*

276. Modern Spanish Drama. The theater of Benavente, Valle-Inclán, Lorca, Casona, Buero Vallejo, Sastre, and Arrabal. 3 units. *Osuna*

277. Modern Spanish Novel. From the Generation of 1898 to the present. 3 units. *Osuna*

For Graduates

300. Research Materials. A study of the most important research tools for Spanish literature: bibliographies, catalogs, reviews, newspapers, and dictionaries. 1 unit. *Staff*

321, 322. Hispanic Seminar. Each semester one of the following topics will be selected for intensive treatment: the Spanish language in America, studies in medieval literature, studies in the literature of the Golden Age, studies in Latin American literature, studies in the Spanish Renaissance and Baroque, studies in Spanish poetry, studies in nineteenth-century Spanish literature, and studies in twentieth-century literature. (Also listed under Medieval and Renaissance Studies.) 6 units. *Fein, Garci-Gómez, Osuna, and Wardropper*

ROMANCE LANGUAGES

218. The Teaching of Romance Languages. Evaluation of objectives and methods; practical problems of language teaching at the elementary, secondary, and college levels; analysis of textbooks, texts, and audiovisual aids; applied linguistics. 3 units. *Hull*

Slavic Languages and Literatures

Professor Krynski, *Chairman* (314 Languages); Associate Professor Jezierski

The Department of Slavic Languages and Literatures offers graduate courses in Russian language and literature and limited training in the language and literature of Poland.

Students should have sufficient preparation in the Russian language to enable them to read Russian classical literature in the original.

For Seniors and Graduates

201, 202. Russian Novel of the Nineteenth Century. First semester: 1830-1870. Second semester: 1870-1900. Prerequisite: 161, 162, or equivalent. 6 units. *Krynski*

205. The Structure of Polish in Relation to Russian. Comparative and contrastive study of the two major Slavic languages. Emphasis on preparing students to read Polish literary texts. 3 units. *Krynski*

206. Readings in Contemporary Polish Prose in the Original. Stylistic analysis of aphoristic prose by Stanislaw Lec, philosophical allegories by Leszek Kolakowski, and short stories by Slawomir Mrozek and Marek Hlasko. 3 units. *Krynski*

207. Soviet Literature and Culture. Literature since 1917. Readings in English from major works of prose, poetry, and drama. 3 units. *Jezierski*

207P. Preceptorial. Elective preceptorial for students enrolled in Slavic Languages and Literatures 207. *Jeziarski*

212. Pushkin. Survey of life and works, his role as precursor of modern Russian literature. Readings in English and Russian. Prerequisite: Russian 101 or consent of instructor. 3 units. *Krynski*

225S. Tolstoy. *War and Peace* and other works. Prerequisite: Russian 175S or equivalent. 3 units. *Jeziarski*

227S. Gogol. Life and works: short stories, dramas, and the novel. Readings in English or Russian. 3 units. *Jeziarski*

230. Chekhov. Structural analysis of Chekhov's short stories and plays against the background of contemporary Realist, Impressionist, and Decadent trends in Russian literature. 3 units. *Jeziarski*

230P. Preceptorial. Elective preceptorial for students enrolled in Slavic Languages and Literatures 230. *Jeziarski*

232. Dostoevsky. Emphasis on *Brothers Karamazov* and the theory of the novel. Prerequisite: Russian 176 or equivalent. 3 units. *Jeziarski*

234. Modern Polish Literature. Masterpieces of Polish Literature since 1900. Emphasis on the avant-garde trends and on poetry, drama, and short prose genres. Prerequisite: 3 years of college Russian or 1 year of Polish. 3 units. *Krynski*

Sociology

Professor Back, *Chairman* (268 Sociology-Psychology); Assistant Professor Campbell, *Director of Graduate Studies* (332 Sociology-Psychology); Professors Kerckhoff, Maddox, McKinney, Myers, Palmore, Portes, Preiss, Roy, Smith, and Tiryakian; Associate Professors Hirschman, Simpson, and Wilson; Assistant Professor Rice

The department offers graduate work leading to a Ph.D. degree in sociology. Before undertaking advanced work in this department, a student must have completed a minimum of 12 semester hours of approved preliminary courses in sociology, and an additional 12 semester hours in related work. Applicants for admission should submit scores on the Graduate Record Examination, especially the aptitude test.

Increasingly the department is concentrating its training in three programs: sociology of human development; demography and ecology; and social structure and social change. Students who enter without having chosen a program have their first year to do so if entering with the bachelor's degree or their first semester if entering with a master's degree. Each program has its own course requirements, but all share a six-course requirement covering theory (281) and methodology (295), research methods and techniques (291, 292), and statistics (293, 294). In addition, each program has an informal seminar series and expects extensive student involvement in the research activities of program faculty. All students are expected to participate for training purposes in the teaching program of the department. In order to assure some breadth of training, all students are required to take at least two departmental courses outside the specific course requirements of both their chosen program and the departmental core requirement. Two or four additional courses outside the department in related work are also required.

There is a qualifying procedure after three semesters, or equivalent, to determine whether the student can proceed to the preliminary examination. The latter is an oral examination on a written paper that reviews substantive, theoretical, and empirical aspects of a special field chosen by the student and

accepted by the student's examining committee. Further details concerning the general departmental program, the three specialized programs, departmental facilities, the staff, ongoing research, and various stipends available may be obtained from the Director of Graduate Studies.

For Seniors and Graduates

201. Social Change. Causes, indicators, and consequences. Classical and contemporary theorists Marx, Weber, Sorokin, Parsons, Lenski, and others. 3 units. *Staff*

202. Social Organization. Contrasting conceptions with emphasis on the sustenance and evolution of social arrangements. 3 units. *Staff*

225. Medical Sociology. Current issues in the organization, development, and the utilization of resources for health care. 3 units. *Back or Maddox*

230. Social Aspects of Aging and Death. Theories of human aging; social problems caused by increased longevity, discrimination against the aged, retirement, widowhood, and other role losses. Social-psychological factors in mortality, accidental death, suicide, and murder. 3 units. *Palmore*

234S. Political Economy of Development: Theories of Change in the Third World. (Also listed as Anthropology 234S, History 234S and Political Science 234S.) 3 units. *Berquist, Pessar, Portes, Smith, and Valenzuela*

241. Social Stratification. The nature of hierarchical and vertical differentiation for the economic, political, and prestige structures in modern societies. The interrelationship of class, status, and power strata and their influence on social institutions, personality structure, and group and individual behavior. The transmission of inequality from one generation to the next. 3 units. *Campbell, Hirschman, or Roy*

242. The Sociology of Occupations and Professions. The social significance of work. Analysis of forces changing the contemporary occupational structure, typical career patterns of professions and occupations, and social organization of occupational groups. 3 units. *Roy or Simpson*

243. Population Dynamics and Social Change. Social scientific aspects of the determinants and consequences of population trends. 3 units. *Myers or Hirschman*

244. Human Ecology and Urban Systems. Origins and development of human ecology theory, growth of cities and urban systems, residential segregation of social classes and racial and ethnic groups. 3 units. *Hirschman, Myers, or Smith*

246. Population Policy. Formation, effect, and evaluation. Historical examples of mortality, fertility, migration, and distribution policies. The Malthusian and neo-Malthusian controversies. Psychological, sociological, demographic, and political background. (Also listed as Public Policy Sciences 246.) 3 units. *Back*

251. The Sociology of Modernization. Theories and perspectives on the nature of modernization and modernity in Western and non-Western countries. 3 units. *Hirschman, Tiryakian, or Portes*

254. Urbanization and Social Change. Interactions between social structure and physical space in three contexts: (a) the re-emergence of cities in Medieval Europe; (b) the contemporary evolution of cities and their hinterlands in the United States; and (c) patterns of urbanization in the Third World. 3 units. *Portes*

259. Religion and Social Change. The role of religion in significant social changes in Western and non-Western societies; noninstitutional phenomena (charisma, prophecy, messianism, revivals, glossolalia). 3 units. *Tiryakian or Wilson*

260. Science, Technology, and Society. Science as a social phenomenon. Relations of science to technology and their articulation through public policy. Interaction of the institutions of science with other societal institutions. 3 units. (Also listed as Psychology 260.) *McKinney and Bevan*

261. Science, Politics, and Government. The structure and values of the scientific community, the mechanism and strategies of government, and their mutual interdependence in American society. (Also listed as Public Policy Sciences 255 and Psychology 261.) 3 units. *Bevan and McKinney*

272. The Socialization Process. Mechanisms and variations in socialization by position in the social structure (class, race, urban-rural); contributions made by various socialization agencies (family, school, peer groups, mass media) in Western society. 3 units. *Kerckoff*

275. Social Structure and Personality. Processes by which social structures and social change (including class, modernization, societal, and organizational membership) affect individual attitudes and behaviors. Nature and effect of stress, alienation, and other forms of incongruence between individuals and social structures. 3 units. *Portes*

276. Small Groups and Social Life. A systems theoretical approach. Basic group processes including communication, integration, subgroup formation, specialization, hierarchy, and leadership; different types, contexts and interrelations of groups. 3 units. *Back*

278. Social Structure and the Life Cycle. Relationship between age as a social characteristic and social interaction, with particular reference to adolescence and old age. 3 units. *Maddox*

281. Seminar in Sociological Theory. Development, convergence, and utilization of sociological theories. 3 units. *Tiryakian or Wilson*

282S. Seminar on Canada. See course description for History 282S. (Also listed as Anthropology 282S, Economics 282S, and Political Science 282S.) 3 units. *Staff and visitors*

291. Research Methods and Techniques I. Principles and methods of collecting and utilizing questionnaire and survey data. Applications of methods, secondary analysis, laboratory and field experimentation, observation and other types of research. Prerequisite: Sociology 132 or 293, or equivalent. 3 units. *Portes or Smith*

292. Research Methods and Techniques II. Principles, methods, and applications of depth interviewing, participant observation, content analysis, unobtrusive measures, historical, and archival analysis. Issues of reliability, validity, quantification, multiple methodologies, and the interrelationship of theory and method. 3 units. *Roy*

293. Introductory Statistical Analysis. Basic descriptive statistics, regression and correlation, t-tests and the analysis of variance, chi square techniques, and other topics. Stress on practical applications. Statistical computing using SPSS and other programs. 3 units. *Campbell or Rice*

294. Intermediate Statistical Analysis. The general linear model and its application in methods of multivariate statistical analysis: analysis of variance and covariance, multiple regression and path analysis, and log-linear models for

categorical data. Statistical computing using SPSS and other programs. Prerequisite: Sociology 293 or equivalent. 3 units. *Campbell or Rice*

295. Methodology in Sociology. The nature of scientific method, as well as alternative paths to knowledge, as they apply to sociology. Conceptualization, hypothesis formation, and definition. The research process as a decision-making situation for both general research design and specific techniques. The process and logic of data analysis. Relations of theory and research are stressed. 3 units. *Back or Smith*

298S, 299S. Seminar in Selected Topics. Substantive, theoretical, or methodological topics. 3 units each semester. *Staff*

For Graduates

301. Seminar in Human Fertility. Special topics in human fertility including: theory of demographic transition, fertility in Latin America, design and evaluation of family planning programs, fertility and problems of modernization, and family structure and fertility. 3 units. *Back*

302. Seminar in Migration. Special topics in migration including: Latin American rural-urban migration, urban migration policy, contemporary migration theories, and international migration. 3 units. *Myers or Smith*

325. Social Aspects of Mental Illness and Treatment. An examination and critique of sociological research and theory in the epidemiology, etiology, and treatment of mental illness. Such topics as the effect of mental illness on the family, the structure and function of various treatment systems, and major problems of methodology will receive emphasis. 3 units. *Back or Preiss*

341. Special Problems of Complex Systems. (a) *Industrial and Professional Systems.* Analysis of problems of organization of work in such diverse settings as industrial plants, hospitals, and public administration groups. Problems of decision-making, recruitment, allocation of authority, informal organization, interorganizational relations. 3 units. *McKinney, Roy, or Simpson*

(b) *Mass Communications.* Theoretical problems in defining and distinguishing communication, communicative acts, communication processes, and communication systems. Work aimed toward the derivation of models and theories for each of these will be pursued. 3 units. *Smith*

(c) *Urban Society.* Analysis of the varying mechanisms through which urban society is integrated, how urbanites develop a sense of identification with the community, the extent and mode of social dominance of the city in the larger society. 3 units. *Myers or Smith*

344. Workshop on Computer Models of Social Systems. The methodology of building mathematical and logical models of social systems and computer simulation experiments with such models. The types of models and social systems surveyed have applications in business administration, economics, education, political science, psychiatry, psychology, and sociology. Participants in the workshop will develop and conduct simulation experiments with a model of some complex social system, such as a city, state, region, or nation. (Also listed as Computer Science 344, Economics 344, and Political Science 344.) 3 units. *Naylor*

345, 346. Demographic Techniques I and II. Measurement and methodology in demography. The first course deals primarily with basic measurement techniques including standardization, construction of the life table, period and cohort measures of fertility, and introduction to classical population theory. The second is devoted to the analysis of complex models such as family building models and

growth and projection models and the preparation of a research topic. (Also listed as Economics 345, 346.) 3 units each semester. *Myers*

349, 350. Seminar in Selected Topics of Demography and Ecology. Social, economic, and environmental determinants or consequences of population structure and trends. A broad, multidisciplinary, cross-national and processual perspective is stressed. 3 units each semester. *Staff*

373, 374. Social Psychological Issues in Sociology. Detailed exploration of selected problem areas such as the theory and measurement of social attitudes, role discontinuity and personality disorders, applications of reference group theory, the socialization process. 3 units each semester. *Back, Kerckhoff, and Preiss*

385. Seminar in Sociological Theory. Analysis of methodological and substantive problems in utilizing comprehensive, middle-range, and discrete theories in varied sociological areas. Major emphasis on the use of theory in empirical research. Prerequisite: Sociology 281 or equivalent. 3 units. *McKinney and Tiryakian*

386. Seminar in Sociological Theory. Focuses on the theoretical and research implications of existential phenomenology, drawing from such sources as Husserl, Merleau-Ponty, and Schutz. Attention will be given to recent sociological interests in this area (e.g., ethnomethodology). Prerequisite: Sociology 281 or equivalent. 3 units. *Tiryakian*

390. Seminar in Field Methods of Sociological Research. The primary aims of this course will be two-fold, (a) to consider at length and in detail various procedures and problems of observing human behavior in natural group, organizational, and community settings, and (b) to give the neophyte researcher elementary training in first-hand observation and face-to-face interviewing. 3 units. *Roy*

392. Individual Research in Sociology. Students will conduct on an individual basis research designed to evaluate a sociological hypothesis of their choice. The process must be completed by preparation of a report on this research in adequate professional style. Prerequisite: Sociology 295 or consent of instructor. 3 units. *Back or Smith*

397, 398. Seminar in Special Research. 3 units each semester. *Staff*

402. Interdisciplinary Seminar in the History of the Social Sciences. A survey of the theories, methods, and tools applied to problems in the history of the social sciences. 3 units. *Goodwin, Holley, and Spragens*

Zoology

Professor Wainwright, *Chairman* (227 Biological Sciences); Professor Tucker, *Director of Graduate Studies* (0040 Biological Sciences); Professors Bailey, Costlow, Fluke, Gillham, Gregg, Klopfer, Livingstone, Nicklas, Schmidt-Nielsen, Ward, and K. Wilbur; Adjunct Professor Schmidt-Koenig; Associate Professors Barber, Forward, Lundberg, McClay, Sutherland, Vogel, and H. Wilbur; Assistant Professors Nijhout, Rauscher, and Storey

The Department of Zoology manages a variety of programs tailored to individual needs of students seeking A.M. or Ph.D. degrees.

In general, students entering the department will be equipped to pursue advanced degrees if they have completed an undergraduate major in biology along with some formal training in college-level chemistry, mathematics, physics, and foreign languages.

Nevertheless, in recognition and support of the modern trend toward interdisciplinary research, the department is prepared to accept promising students with

less orthodox academic backgrounds and is ready to encourage any student wishing to undertake a program of study leading, in effect, to an interdisciplinary degree sponsored by the department.

Thus, all students are urged to search widely in the *Bulletin of Undergraduate Instruction* and the *Bulletin of the Graduate School* for information about the intellectual resources of the University. Special attention should be given to announcements of the Departments of Anatomy, Anthropology, Biochemistry, Botany, Chemistry, Geology, History, Mathematics, Microbiology and Immunology, Pharmacology, Philosophy, Physiology, Psychology, Sociology, and Zoology; announcements of the Schools of Engineering and Forestry should also be consulted.

For Seniors and Graduates

The *L* suffix on a zoology course number indicates that the course includes a laboratory.

201L. Animal Behavior. Physiological and developmental studies. Laboratory emphasizes research projects. Prerequisites: physiology, genetics, or consent of instructor. Evolution recommended. 4 units. *Klopper*

203L. Marine Ecology. Application of ecological theory to marine systems. Mathematical properties of population growth and species interactions; field and laboratory projects with computer-assisted analysis of data. Practice in scientific writing. Readings from current scientific publications. Prerequisites: introductory biology or invertebrate zoology, and calculus; knowledge of statistics is recommended. (Also listed under Marine Sciences.) (Given at Beaufort.) 6 units. *Sutherland*

204L. Population and Community Ecology. Theoretical aspects of population dynamics and of systems of interacting species. Individual projects and reports, several weekend field trips. Prerequisites: calculus, introductory ecology, and consent of instructor. 4 units. *H. Wilbur*

205. Foundations of Theoretical Biology. Logic, mathematics, and philosophy in the biological sciences. Formal and empirical roles of hypotheses, definitions, deductions, classifications, orderings, and measurements, as exemplified by simple theoretical systems and their biological models. Selected philosophical issues of biological thought. Prerequisites: introductory biology and mathematics, or consent of instructor. 3 units. *Gregg*

214L. Biological Oceanography. Impact of biological processes on the physical and chemical character of the environment and the regulating role of abiotic processes on organic productivity. Factors regulating primary and secondary productivity with the estuary and ocean as examples. Emphasis on design and execution of directed research. Prerequisite: consent of instructor; introductory biological or chemical oceanography is recommended. (Also listed under Marine Sciences.) (Given at Beaufort.) 6 units. *W. Smith (visiting summer faculty)*

216L. Limnology. Lakes, ponds, and streams; their origin, development, geochemistry, energy balance, productivity, and the dynamics of plant and animal communities. Laboratory includes field trips. Offered biennially. Prerequisites: introductory biology, Chemistry 12, physics, and Mathematics 32 or consent of instructor. 4 units. *Livingstone*

218L. Pleistocene Paleobiology. Causes and consequences of climatic change: human, climatic, and biogeographic factors in history of vegetation; effects of environmental change on evolutionary strategies, ecosystem development, and human culture. Includes discussions, oral reports, study of lake sediments includ-

ing pollen analysis. Prerequisites: one year of biology or geology and consent of instructor. 4 units. *Livingstone*

222L. Entomology. The biology of insects: diversity, development, physiology, and ecology. Laboratory twice weekly; field trips. Prerequisite: introductory biology. 4 units. *Nijhout*

224L. Herpetology. Classification, evolution, zoogeography, and natural history of amphibians and reptiles. Lectures, demonstrations, and readings on world fauna; laboratory and field work on the Carolina fauna. Prerequisite: Zoology 108L and consent of instructor; introductory ecology recommended. 3 units. *Bailey*

226L. Ichthyology. Diversity, evolution, natural history, and ecology of fishes. Laboratory includes overnight field trips to marine and freshwater habitats. Prerequisites: introductory biology and Zoology 108L. 3 units. *Lundberg*

229. Morphogenetic Systems. Introduction to the experimental study of development. Gametogenesis and fertilization, formation of primary axes, interactions of nucleus and cytoplasm, morphogenetic movements, embryonic induction, regeneration, energetics. Prerequisite: introductory biology. 3 units. *Gregg*

235. Evolutionary Systematics. Speciation and phylogeny in plants and animals: geographic and reproductive isolation, breeding systems, hybridization, homology, convergence, and extinction; techniques of classification. Complements Zoology 286. Prerequisite: introductory biology. (Also listed as Botany 135, Botany 235, and Zoology 135.) 3 units. *Bailey, Lundberg, and Stone (botany)*

239S. Biogeography. Old and new distributional concepts of animals and plants involving physical geography, geology, paleontology, systematics, evolution, population dynamics, and dispersal. Prerequisite: consent of instructor. 3 units. *Bailey*

244. Principles of Immunology. An introduction to the molecular and cellular basis of the immune response. Topics include anatomy of the lymphoid system, lymphocyte biology, antigen-antibody interactions, humoral and cellular effector mechanisms, and control of immune responses. Prerequisites: Zoology 160, Chemistry 152; or consent of instructor. (Also listed as Microbiology 244.) 3 units. *Dawson and staff*

245. Radiation Biology. Actions of ionizing and excitational radiations on life processes; biological use of radioactive tracers; nucleonics. Prerequisites: physics, Mathematics 32, and Chemistry 12. 3 units. *Fluke*

247S. Photobiology. Effects of visible light and of ultraviolet and near ultraviolet radiation in living systems: repair processes, quantum processes, physical optics. Prerequisites: college physics and introductory biology. 3 units. *Fluke*

249. Biomechanics. Principles of fluid and solid mechanics applied to biological systems. Prerequisites: Physics 51 and Mathematics 31 or equivalent. 3 units. *Vogel and Wainwright*

250L. Physiological Ecology of Marine Animals. The physiology of marine animals as related to environmental factors of salinity, temperature, oxygen, and light. Prerequisite: a course in physiology. (Also listed under Marine Sciences.) (Given at Beaufort.) 6 units. *Forward*

252. Comparative Physiology. The physiological mechanisms of animals studied on a comparative basis. Prerequisite: Zoology 151L. or equivalent. 4 units. *Schmidt-Nielsen*

258L. Laboratory Research Methods. Radioactivity and scintillation counting, spectrophotometry and enzyme kinetics, protein and cell component separatory methods, other analytical methods, according to individual research interests. Prerequisite: consent of instructor. 4 units. *K. Wilbur, Fluke, and staff*

260. Advanced Cell Biology. Structural and functional organization of cells and their components; current research problems and prospects. Prerequisites: introductory cell biology (or genetics and consent of instructor); introductory biochemistry recommended (may be concurrent). 3 units. *Nicklas, K. Wilbur, and staff*

262L. Cytological Materials and Methods. Cytological analysis, with emphasis on chromosome studies using advanced optical, cytochemical, and experimental techniques. Prerequisite: Zoology 260 or equivalent. 3 units. *Nicklas*

265S, 266S. Seminar in Chromosome Biology. Current research in chromosome structure and function, mitosis, and meiosis. Prerequisites: a course in cell biology or genetics, and consent of instructor. (Also listed as Anatomy 265S, 266S.) 2 units each semester. *Moses (anatomy) and Nicklas*

274L. Marine Invertebrate Zoology. Structures, functions, and habits of invertebrate animals under natural and experimental conditions. Field trips included. Not open to students who have had Zoology 175 or 275. Prerequisite: introductory biology. (Also listed under Marine Sciences.) (Given at Beaufort.) 6 units. *Seed (visiting summer faculty)*

278L. Invertebrate Developmental Biology. Gametogenesis, fertilization, and development of invertebrates, with emphasis on experimental studies of prelarval stages. Prerequisite: consent of instructor. (Also listed under Marine Sciences.) (Given at Beaufort.) 4 units. *McClay and visiting staff*

280. Principles of Genetics. Structure and properties of genes and chromosomes in individual organisms and in populations. Prerequisites: introductory biology, Chemistry 12, and Mathematics 31, or equivalents. (Also listed as Botany 180, Botany 280, Zoology 180, and under the University Program in Genetics.) 3 units. *Antonovics (botany), Boynton (botany), and Gillham*

281L. Marine Invertebrate Larvae. Descriptive survey of life cycles, developmental stages, and metamorphosis, with emphasis on larval stages of marine invertebrates; collection, identification, and culture of larval forms in estuarine, inshore, and oceanic plankton and sediments. Prerequisites: zoology or consent of instructor. 4 units. *Lehman*

283. Extrachromosomal Inheritance. Genetics, biochemistry and molecular biology of the organelles of eukaryotic cells, bacterial plasmids and episomes, and cellular symbionts. Emphasis on recent literature. Prerequisite: introductory genetics. (Also listed as Botany 283, and under the University Program in Genetics.) 3 units. *Boynton (botany) and Gillham*

286. Evolutionary Mechanisms. Population ecology and population genetics of plants and animals. Fitness concepts, life history evolution, mating systems, genetic divergence, and causes and maintenance of genetic diversity. Complements Zoology 235. Prerequisite: genetics. (Also listed as Botany 286 and under the University Program in Genetics.) 3 units. *Antonovics (botany) and H. Wilbur*

288S. The Cell in Development and Heredity. A seminar on topics of current interest and controversy. Prerequisites: a course in genetics and consent of instructor. (Also listed as Anatomy 288S and under the University Program in Genetics.) 2 units. *Counce (anatomy)*

289S. Problems in Genetics. Selected topics in current research. Prerequisite: introductory genetics and consent of instructor. (Also listed under the University Program in Genetics.) 3 units. *Gillham*

295S, 296S. Seminar. Topics, instructors, and course credits announced each semester. *Staff*

For Graduates

351, 352. Departmental Seminar. A weekly meeting of graduate students and faculty to hear and discuss research reports. 1 unit credit by arrangement. *Staff and invited lecturers*

353, 354. Research. To be carried on under the direction of the appropriate staff members. Hours and credit to be arranged. *Staff*

355, 356. Seminar. One or more seminar courses in particular fields are given each semester by various members of the staff. 2 units. *Staff*

360, 361. Tutorials. Students will write essays based on reading of literature. Essays will be discussed and critically evaluated in meetings. 2 units each semester. *Staff*

Genetics, The University Program. Genetics courses offered by the Department of Zoology are part of the University Program in Genetics; see announcement in this bulletin.

Marine Laboratory. Consult Marine Sciences in this bulletin for offerings at the Duke University Marine Laboratory.

Program in Tropical Biology. Fellowships are available for travel and subsistence in field-oriented programs in Latin America. Refer to the section, Organization for Tropical Studies, in this bulletin in the chapter on Special and Cooperative Programs.

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*Graduate School
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Administration*

bulletin of
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80

*Graduate School
of Business
Administration*

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PHOTOGRAPHS
Thad Sparks

COVER DESIGN
Donna S. Slade

Typesetting by Electronic Composition, Inc., Washington, D.C.
Printed by Greensboro Printing Company, Greensboro, N.C.

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Graduate School of Business Administration Calendar

1979

August 30–31 Orientation and Registration
September 4 Classes begin
November 21–23 Thanksgiving break

December 11 Classes end
December 14–20 Examination period

1980

January 14 Classes begin
March 10–15 Spring break
April 25 Classes end

April 29–May 5 Examination period
May 11 Commencement

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A Message from the Dean

Students completing graduate study in business administration in the next several years will embark on careers that will carry them into the twenty-first century. The social, technological, and economic changes they face will be rapid and sweeping. Leaders of organizations will face problems that are currently undefined, with solutions equally unknown. Our challenge, therefore, is to develop for each student, a foundation upon which learning will continue to grow to meet future needs.

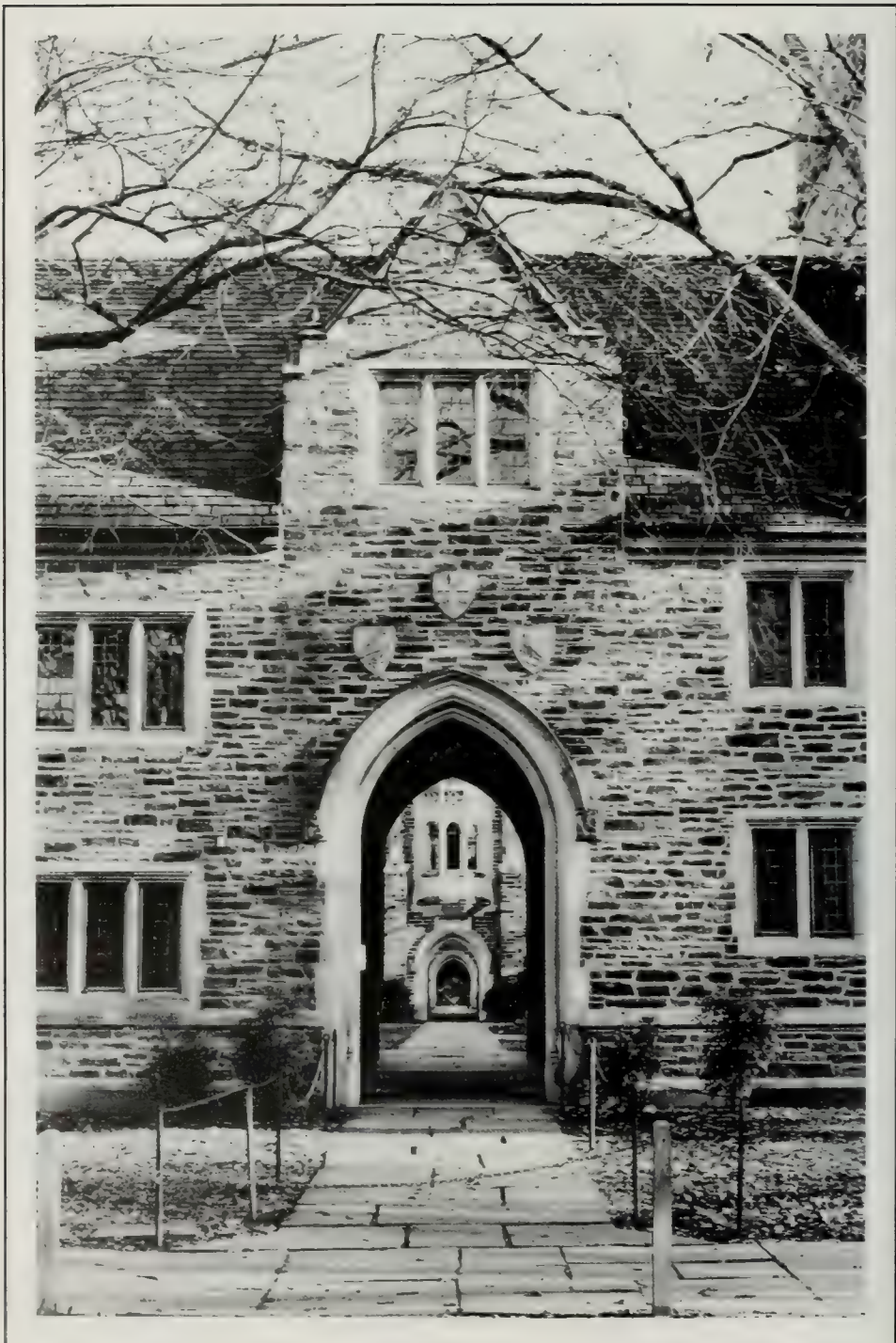
The Master of Business Administration is the professional degree for individuals desiring a career in management of complex organizations. The Duke M.B.A. program stresses conceptual thinking and analytical reasoning. This experience provides the student with an understanding of current practices and decision models as a springboard for adaptation and change. Recognizing the complexities of economic pursuits, now and in the future, the Graduate School of Business Administration offers concurrent degree programs with the School of Law, the School of Forestry and Environmental Studies, and the Institute of Policy Sciences. These programs recognize certain common bodies of knowledge and are designed to reduce the amount of time normally required to obtain two advanced degrees.

Our heritage at Duke is a tradition of excellence in education. We, at the Business School, have built upon this heritage to develop business programs whose graduates will meet the challenges of our changing environment and will attain positions of leadership in business firms, government, and educational organizations. This is our stated goal and we are achieving it.

A handwritten signature in black ink, reading "Thomas F. Keller". The signature is fluid and cursive, with a small mark at the end of the last name.

Thomas F. Keller
Dean

General Information



Duke University

In 1839 a group of citizens from Randolph and adjacent counties in North Carolina assembled in a log schoolhouse to organize support for a local academy founded a few months earlier by Brantley York. Prompted, they said, by "no small share of philanthropy and patriotism," they espoused their belief that "ignorance and error are the banes not only of religious but also civil society which rear up an almost impregnable wall between man and happiness." Union Institute, which they then founded, was reorganized first in 1851 as Normal College to train teachers, and eight years later as Trinity College, a liberal arts college, which later moved to the growing city of Durham, North Carolina. With the establishment of the James B. Duke Indenture of Trust in 1924, Trinity College became Duke University. Today, Duke is a two-campus institution with a student body of about 9,000, of whom 3,000 are enrolled in the graduate and professional programs. Established in 1969, the Graduate School of Business Administration joined the Schools of Medicine, Nursing, Law, Engineering, Divinity, and Forestry in preparing qualified individuals for professional leadership and developing excellence in education for the professions.

The Campus. The main campus (West) of Duke University is a beautifully designed complex of buildings in Gothic architecture, bordered on the east by the Sarah P. Duke Gardens and on the west by the 8,000-acre Duke Forest. The Business School is located on the main quadrangle of the West Campus. The William R. Perkins Library, one of the largest research libraries in the country, is located directly opposite the school. This campus is dominated by the Duke Chapel, whose 210-foot-high tower houses a 50-bell carillon. The East Campus is a smaller complex of Georgian-style buildings and has, as a major point of interest, the Duke University Museum of Art.

Durham is a part of the Research Triangle, an area formed by Duke University, the University of North Carolina at Chapel Hill, and North Carolina State University at Raleigh. The Research Triangle Park, a 5,400-acre campus for research laboratories, governmental agencies, and research-oriented industries, is recognized as one of the world's leading science centers. Durham, located near the center of the state, has easy access to the Great Smokies of the Appalachian Mountains and to the scenic and historic beaches of the Outer Banks. The area offers varied cultural and recreational activities ranging from concerts, opera, dance, theater, and recitals to intramural and collegiate sports, boating, skiing, camping, and other outdoor activities.



Resources of the University

The Library System. The libraries of the University consist of the Perkins Library and its eight branches on campus: Biology-Forestry, Chemistry, Divinity, the East Campus Library, Engineering, Music, Physics-Math, and the Undergraduate Library; and the Pearse Memorial Library at the Duke Marine Laboratory in Beaufort. Also located on West Campus are the Law Library and the Medical Center Library and Communications Center. In June 1977, these libraries contained approximately 2,800,000 volumes and ranked seventeenth in size among academic libraries in the United States. More than 14,000 periodicals, 20,000 serials, and 200 newspapers are received regularly. The collection includes about 5,000,000 manuscripts, 70,000 maps, 28,000 sheets of music, and 235,000 rolls or sheets of microtext.

The William R. Perkins Library. The William R. Perkins Library—the main library of the University—houses most of the books and journals in the humanities and social sciences, large files of United States federal and state documents, public documents of many European and Latin American countries, publications of European academies and learned societies, and special collections from South Asian, Far Eastern, and Slavic countries. The newspaper collection, with 15,000

volumes and 30,000 reels of microfilm, has several long eighteenth-century files, strong holdings of nineteenth-century New England papers and antebellum and Civil War papers from North Carolina, South Carolina, and Virginia, as well as many European and Latin American papers. The manuscript collection of approximately five million items is particularly strong in all phases of life in the South Atlantic region. It also includes significant papers in English and American literature. The rare books collection contains materials covering a broad range of fields, and the Latin and Greek manuscripts constitute one of the outstanding collections in the United States. The collection of Confederate imprints is the largest in the country.

Tours of the Perkins Library are given frequently during Orientation Week and upon request throughout the year. Information about other campus libraries may be obtained from the staff in each of the libraries. Handbooks about library services and facilities are also available in each of the libraries.

Computation Center. The Duke University Computation Center provides the University faculty and students with a facility for research and instruction. The center is presently equipped with an IBM 370/138 computer with 1024 thousand bytes of memory, one 3330-type disk facility, three tape drives, two card readers, a card punch, three printers, and a digital plotter which is connected by a high-speed microwave link to an IBM 370/165 computer (four million and three million bytes of memory, one 2314 and two 2330-type disk facilities, seven tape drivers, card reader, and printer) located in the Research Triangle Park at the Triangle Universities Computation Center (TUCC), a nonprofit corporation formed jointly by Duke University, North Carolina State University at Raleigh, and the University of North Carolina at Chapel Hill. TUCC also has a Hewlett-Packard 2000F computer which provides BASIC interactive computing. Duke has three medium-speed terminals (card reader and printer), located in the Engineering Building, the Biological Sciences Building, and the Sociology-Psychology Building, as well as several other low-speed keyboard terminals, connected to TUCC.

All users of the Computation Center facilities are urged to obtain funds to pay for computer services. Users unable to obtain grant funding may ask for financial support from their departments when applying for services. More specific information regarding Duke computing facilities may be obtained from the director of the Computation Center.

Programs of Study



The Master of Business Administration Program

The Duke M.B.A. degree is designed to prepare the individual to meet the challenges of rapid change in society through emphasis on concepts and analytical reasoning. The student is asked to structure unstructured situations and to propose solutions to complex problems. The particular focus on concepts and theory produces special qualities in the Duke M.B.A. graduate. By studying managerial theory and economic principles, the student acquires the capacity of assuming responsibility in a wide variety of specific assignments within an organization. By studying the problems of economic enterprise in an integrated fashion, the student develops a broader perspective for decision-making. By studying analytical tools and problem structures, the candidate learns to identify common forms of problems that in many respects appear to be different and to grasp the essential nature of problems in unfamiliar functions.

Outline of the Curriculum

The M.B.A. degree requires four semesters of full-time work totaling 60 units of graduate course credit. On rare occasions, students who are exceptionally proficient in a particular subject will be allowed to substitute advanced course work for one or more core courses. There are no summer sessions for students in the M.B.A. program. The resources of the school are available to assist students in finding summer employment related to their interests which will aid in the selection of second-year electives. In many cases, the student electing the practicum may select a topic and begin work on it during the summer.

Students entering the M.B.A. program are expected to have a working knowledge of calculus, and the school offers a short course in August for students who have not had calculus or who feel the need for a refresher course.

The First-Year Program. Course work in the first year is designed to provide the basic knowledge and tools for analysis of the operation of an organization. In the second semester of the first year, students are introduced to the functional areas of the firm. The first-year program includes:

Fall Semester

B.A. 300	Managerial Economics	3 units
B.A. 311	Statistical Analysis for Management	3 units
B.A. 312	Quantitative Analysis for Management	3 units
B.A. 320	Organization Behavior	3 units
B.A. 330	Financial Accounting	3 units
B.A. 318	Computer Laboratory	Noncredit
		<hr/> 15 units

Spring Semester

B.A. 301	Economic Environment of the Firm	1½ units
B.A. 321	Organization Design	1½ units
B.A. 331	Managerial Accounting	3 units
B.A. 350	Financial Management	3 units
B.A. 360	Marketing Management	3 units
B.A. 370	Operations Management	3 units
B.A. 388	Business Communications	Noncredit
		<hr/> 15 units

The Second-Year Program. The second year of the M.B.A. program consists of two required courses and eight electives. The required courses stress the application of knowledge gained in the first year to the overall management process, to the integration and coordination of the planning function, and to strategy formulation and implementation. A key feature of the second year is the management game which is used in B.A. 340, The Management Experience. The management game places teams of students in key management positions of firms which compete in a simulated market environment. Student teams are responsible for all aspects of their firm's operations, including formulation of objectives, design of the organizational structure, and decision-making in marketing, production, finance, and personnel. Fund-raising activities by firms are accomplished by negotiation between individual teams and local bankers. Each student team reports to a board of directors composed of faculty and business executives from the community. The course, B.A. 341, Corporate Strategy and Public Policy, deals with the strategic planning process from the viewpoint of the firm, as well as with the public policy role of the firm in our society.



The eight electives allow the students to develop additional depth in functional areas and freedom to concentrate their studies in a specific area of interest. Of the elective courses, one must be chosen from the environmental field which deals with the managerial implications of the economic, legal, social, and political environment of the firm. The courses satisfying this requirement are B.A. 302, B.A. 342, and B.A. 345. The student may also elect up to four courses from other graduate and professional schools at Duke, allowing the development of an individual program consistent with career goals.

The second-year program includes:

Fall Semester

B.A. 340	The Management Experience	3 units
	Elective	3 units
	Elective	3 units
	Elective	3 units
	Elective	3 units
		<hr/>
		15 units

Spring Semester

B.A. 341	Corporate Strategy and Public Policy	3 units
	Elective	3 units
	Elective	3 units
	Elective	3 units
	Elective	3 units
		<hr/>
		15 units

The Doctor of Philosophy Program

The purpose of the Ph.D. program is to prepare candidates for research and teaching careers at leading educational, governmental, and business institutions. The program places major emphasis on independent inquiry, and on the development of competence in research methodology and the communication of research results. Students are introduced at the outset of the program not only to rigorous course work, but also to the research activities of the faculty and of other students. Opportunities generally exist for students to participate in research projects conducted by faculty, and for advanced students to teach at least one course at the undergraduate level. Throughout the program, students maintain a close working relationship with members of a faculty committee, which may last well beyond the time the degree is conferred.

Course Requirements. The program accepts students with a bachelor's degree and usually lasts three to four years. Prerequisites for the program include a one-year course in calculus, one course in linear algebra, and proficiency in a scientific computing language. The specific program of study is determined by the student and faculty adviser, subject to the approval of the director of the doctoral program. Generally, the first year of study closely parallels the M.B.A. program, serving to impart an integrated viewpoint of the marketing, financial, operational, and informational aspects of organization management. The courses are based on rigorous foundations in economic theory, organization theory, accounting, optimization theory, and mathematical statistics. Subsequent study is devoted to developing knowledge of the research literature in one or more areas related to management. The extent of this knowledge should permit the student to begin contributing authoritative works to that literature. This concentration requirement

is usually satisfied in an area through a combination of regular course work, seminars, research participation, and directed reading.

As a minimum, 30 units of course work beyond the Duke M.B.A. or its equivalent are required for the Ph.D. degree. Included among the entire collection of courses in the Ph.D. program should be two courses in advanced economic theory, two in mathematics or statistics, and three in an elected field of administration. Many of the advanced and specialized courses are offered in a tutorial format, affording the participants great flexibility in their choice of topics and depth of study. Throughout the program, much emphasis is placed on a thorough understanding of subject matter, and on excellence in the structuring and presentation of ideas.

Preliminary Examination. Economic theory, quantitative methods, and an elected field of administration are the areas covered by the preliminary examination. Usually, the examination is taken upon completion of the formal course requirements, at about the same time work on the dissertation is begun. The examination is intended to provide evidence of the student's depth of understanding in the above areas and of a capability to complete the Ph.D. program.

Doctoral Dissertation. The doctoral dissertation is expected to be original research in some area of theory, analytic methods, or administrative application related to improvement of management. The main purpose of the dissertation should be to contribute to knowledge pertinent to the management of organizations.

Final Examination. The final examination is conducted orally. Usually it dwells primarily on material related to the doctoral dissertation.

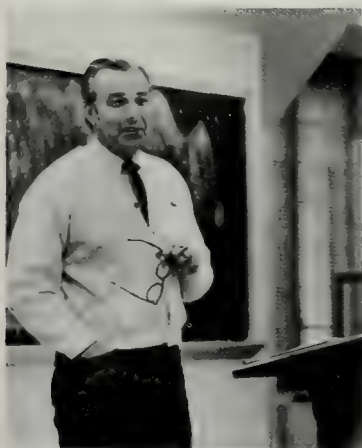
Special Programs

CONCURRENT DEGREE PROGRAMS

The Graduate School of Business Administration offers combined degrees with the School of Law, the School of Forestry and Environmental Studies, and the Institute of Policy Sciences and Public Affairs. By recognizing certain areas of study common to the M.B.A. and each of the other advanced degrees, duplication of instruction is eliminated and students are able to obtain the concurrent degrees in less time than would normally be required to obtain the two degrees separately.

The M.B.A.-J.D. The concurrent M.B.A.-J.D. program requires four academic years of study with a full year in each school and two years of combined study that meets the requirements for both the M.B.A. and J.D. degrees. Students must apply for admission and be accepted by both the School of Law and the Graduate School of Business Administration. Additional information on the program may be obtained from the director of admissions, Duke University Graduate School of Business Administration, and the admissions office, Duke University School of Law.

The M.B.A.-M.F. and the M.B.A.-M.E.M. The concurrent Master of Business Administration and Master of Forestry or Master of Environmental Management degrees normally require three years of study. Students must apply for admission and be accepted by both the School of Forestry and Environmental Studies and the Graduate School of Business Administration. Additional information on the program may be obtained from the director of admissions, Duke University Graduate School of Business Administration, and the director of admissions, Duke University School of Forestry and Environmental Studies.



The M.B.A.-A.M. in Public Policy Sciences. The concurrent Master of Business Administration degree and Master of Arts degree in Public Policy Sciences normally require two to three years of study. The joint degree curriculum requires a minimum of ten courses to be specified by the Institute of Policy Sciences and Public Affairs. Four of these courses may be considered as electives in the M.B.A. program. Students must apply to, and be accepted by, both the Graduate School and the Graduate School of Business Administration. Additional information may be obtained from the director of admissions, Duke University Graduate School of Business Administration, and the director of graduate studies, Institute of Policy Sciences and Public Affairs.

COMBINED UNDERGRADUATE-PROFESSIONAL DEGREES

Also known as the "three-two" program, the combined undergraduate-professional degree program provides that the Bachelor of Science or Bachelor of Arts degree may be awarded to students who successfully complete three years in an approved curriculum in arts and sciences at Duke and also the first year of study for the Master of Business Administration. After two years at Duke and before transfer to the Graduate School of Business Administration, students may apply for the three-two program through their academic dean. To be eligible for the combined program a student must successfully complete all baccalaureate requirements (except eight elective courses) and be admitted to the business school.

Students majoring in management sciences need only complete the core course requirements for the management sciences major. Upon satisfactory completion of the first two semesters in the Graduate School of Business Administration, the student will be awarded a baccalaureate degree. The M.B.A. degree is awarded upon completion of the second year of the program.

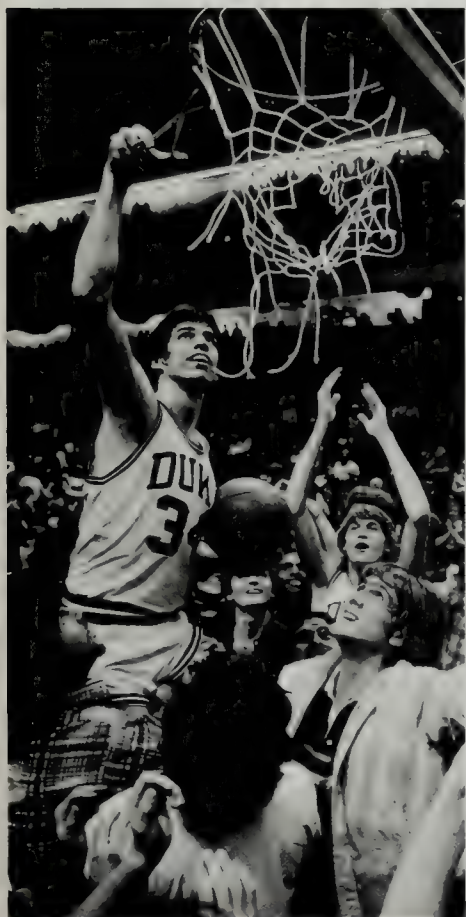
EXECUTIVE PROGRAMS

The Graduate School of Business Administration offers various executive development programs, degree and nondegree. The nondegree programs are designed to meet the needs of business organizations and their executives. The courses vary in length from a few days to three weeks, and are tailored to the requirements of the participating group. The programs are usually residential, giving participants maximum involvement with each other and with the faculty. Programs in cash management, management science in banking, and the management of capital expenditures have been conducted in past years.

The Executive M.B.A. Program is a two-year degree granting curriculum. It is intended for persons currently working in management positions.

Further information on Graduate School of Business Administration Executive Programs may be obtained from John Forsyth, director of executive development programs, Duke University Graduate School of Business Administration.





Admissions



Admission to the Graduate School of Business Administration is open to men and women who hold bachelor's degrees from accredited colleges and universities. No specific undergraduate major is deemed preferable to any other; however, the programs have been designed primarily for persons with training in the liberal arts, engineering, or the sciences. The Admissions Committee seeks those candidates with leadership potential who are prepared to compete successfully in a demanding course of study which requires logical and analytical reasoning.

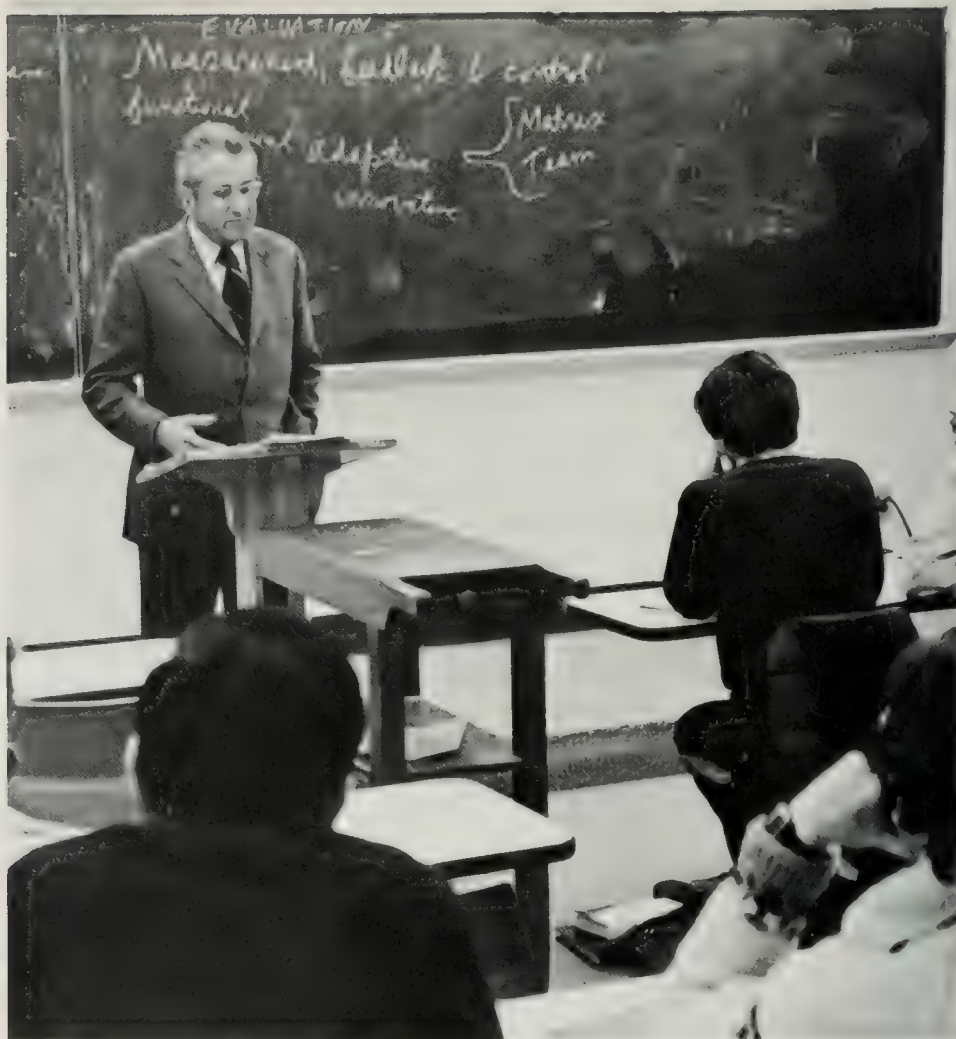
Prior work experience is not considered a requirement for the M.B.A. or Ph.D. programs. However, the Admissions Committee recognizes the value of full-time work experience and considers it a positive factor in admissions decisions.

Application Information. Each applicant must submit the following to the director of admissions before action can be taken:

1. Application Form: Applicants should not feel constrained by the available space on the application form. Since it is desirable that the application be as complete as possible, additional sheets should be used if necessary. Careful completion of the application will ensure a thorough evaluation.
2. College Transcripts: An official transcript from each of the colleges *attended* must be sent from the institution directly to the director of admissions. Students who apply during their senior year must ensure that a final transcript be received by the business school prior to enrolling.
3. Letters of Recommendation: Three letters of recommendation are required and must be sent directly from the writer to the director of admissions. Recent graduates or those in their senior year should have at least two letters submitted from persons familiar with the academic ability of the applicant.
4. Graduate Management Admissions Test: Score reports must be sent directly from the Educational Testing Service to the business school.
5. Application Fee: A nonrefundable fee of \$25 to cover processing must be submitted with the application.

Any questions or requests for application materials should be addressed to the director of admissions, Graduate School of Business Administration, Duke University, Durham, North Carolina 27706.

Application Deadlines. A continuous admissions policy is followed in the Graduate School of Business Administration in that admissions decisions are made as applications are completed. Generally, applications completed by the first of the month will be reviewed, and a decision should be made by the first of the



following month. Application credentials should be on file in the school by 1 April and the application file must be complete before action can be taken. A limited number of places in the class are available for applications completed after 1 April therefore, those wishing to apply after the normal deadline are encouraged to do so.

Admission of Foreign Students. Fully qualified students from outside the United States are welcome at the Graduate School of Business Administration. In applying for admission, the foreign student should submit, in addition to the above credentials, the following:

1. If the native language is not English, certification of ability to use English. Satisfactory performance (generally a total score of 550 and above) on the TOEFL will be viewed as evidence of English ability.
2. A statement certified by a responsible person that the finances are sufficient to maintain the student during the stay at Duke University.
3. A statement by a qualified physician describing the physical and mental health of the applicant.

Notification of Status. When the applicant has been accepted, a letter of admission and an acceptance form will be sent. A nonrefundable tuition deposit of \$50 will be required to reserve a place in the class. The process of admission is not complete until the statement of acceptance and the tuition deposit have been returned to the director of admissions, Graduate School of Business Administration.

Graduate Management Admission Test. The Graduate Management Admission Test, required of all applicants, is administered by the Educational Testing Service. Detailed information about the test and application forms may be obtained by writing directly to the Educational Testing Service, Box 966, Princeton, New Jersey 08540.

The examination is administered at many centers throughout the United States and abroad. Arrangements to take the test at an established center must be made two weeks before the test date (six weeks prior to test date at established foreign centers). The examination is given in November, January, March, and July. Special centers may be arranged for persons distant from established centers. Requests for such accommodations must be made at least three weeks prior to the selected test date. Fellowship applicants should take the test in November or January; other applicants may take it as late as March, but the earlier dates are strongly recommended.

Policy of Nondiscrimination

Duke University does not discriminate on the basis of age, race, color, national and ethnic origin, sex, or handicap, in the administration of educational policies, admission policies, financial aid, employment, or any other University program or activity. Inquiries concerning the University's responsibility may be directed to the director of equal opportunity.

Financial Information



Tuition and Fees

The following table shows tuition and fees for students in the Graduate School of Business Administration for the year 1978–1979. All charges are due and payable at the times specified by the University and are subject to change without notice. Registration is not considered complete, and students may not be admitted to classes, until arrangements have been made with the bursar of the University for the payment of tuition and fees. A late registration fee of \$25 is charged any student not completing registration during the registration periods.

Tuition (full semester program—M.B.A.)	\$1,925.00
Tuition (full semester program—Ph.D.)	1,905.00
Late Registration Fee	25.00
Doctoral Candidate's Fees	
Dissertation Binding Fee (three copies)	16.50
Dissertation Microfilming Fee	30.00
Copyright Fee (optional)	20.00
<i>In Absentia</i> Fee (1 unit per semester)	117.00

After the beginning of classes, no refund will be made except in the event of death or involuntary withdrawal to enter the armed services; refunds will be made on a pro rata basis. In all other cases of withdrawal, students may elect to have tuition charges refunded or carried forward as a credit for later study according to the following schedule:

1. Withdrawal before classes begin: full refund.
2. Withdrawal during the first or second week of classes: 80 percent.
3. Withdrawal during the third, fourth, or fifth week of classes: 60 percent.
4. Withdrawal during the sixth week: 20 percent.
5. Withdrawal after the sixth week: No refunds.

Tuition or other charges paid from grants or loans will be restored to those funds not refunded or carried forward.

Athletic Tickets. Athletic ticket books are available to graduate students. Purchase is optional, with payment due in the fall semester.

Vehicle Fee. Each student possessing or maintaining a motor vehicle at Duke University shall register it at the beginning of the academic year in the Duke Public Safety Office at 2010 Campus Drive. A student who acquires a motor vehicle and maintains it at Duke University after academic registration must register it within

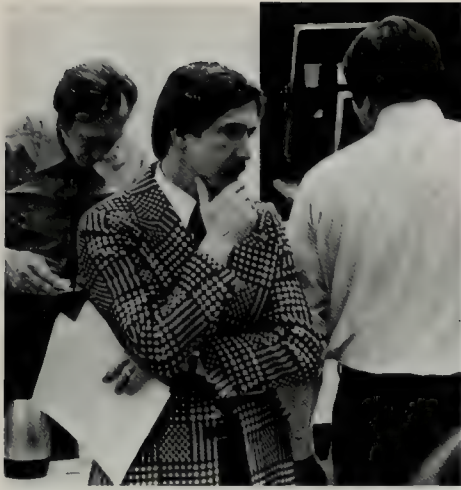


five calendar days after operation on the campus begins. Resident students are required to pay an annual fee of \$20 for each motor vehicle or \$10 for each two-wheeled motor vehicle. Resident students registering a vehicle for the first time after 1 January are required to pay \$14 for a motor vehicle or \$7 for a two-wheeled motor vehicle.

At the time of registration of a motor vehicle the following documents must be presented: state vehicle registration certificate; valid driver's license; satisfactory evidence of automobile liability insurance coverage; and a student identification card.

If a motor vehicle or a two-wheeled motor vehicle is removed from the campus permanently and the decal is returned to the traffic office prior to 20 January, there will be a refund of \$10 for a motor vehicle and \$5 for a two-wheeled motor vehicle.

Transcript Fee. Students who wish to obtain copies of their academic records should direct requests to the registrar's office, 103 Allen Building. Ten days should be allowed for processing. A minimum fee of \$2, payable in advance, is charged for a single copy. When two or more copies are forwarded to a single address, a charge of fifty cents will be made for each additional copy.



Student Health Fee. All students are assessed a fee for the Student Health Service. The fee for 1979-1980 is \$107 (\$53.50 per semester).

Student Accident and Sickness Insurance. The University has made arrangements for a Student Accident and Sickness Insurance Plan to cover all full-time students for a twelve-month period. For additional fees a student may obtain coverage for a spouse and a child. Although participation in this program is voluntary, the University requires all graduate students to be financially responsible for medical expenses above those covered by the University Student Health Program through the University Accident and Sickness Policy, a private policy, or personal financial resources. Students who have equivalent medical insurance or wish to accept the financial responsibility for any medical expense may elect not to take the Duke plan by signing a statement to this effect. *Each full-time student in residence must purchase this student health insurance or indicate the alternative arrangement.* The Student Accident and Sickness Insurance Policy provides protection twenty-four hours per day during the full twelve-month term of the policy for each student insured. Students are covered on and off campus, at home, while traveling between home and school, and during interim vacation periods. The term of the policy is



from the opening day of school in the fall. Coverage, services, and costs are subject to change each year as deemed necessary by the University. The rates for 1978–1979 are: student only—\$95.30 per year; student and spouse—\$222.10 per year; and student, spouse, and children—\$306.90 per year.

Debts. No records are released and no students are considered by the faculty as candidates for graduation until they have settled with the bursar for all indebtedness. Failure to pay all University charges on or before the times specified by the University will bar the student from class attendance until the account is paid in full.

Financial Aid

The Graduate School of Business Administration endeavors to make it possible for qualified students to attend Duke even though their own resources may be insufficient. Financial aid is available in the form of fellowships and various loan programs. Applicants are expected to make use of personal savings, veterans' benefits, summer income, and loans from family and other outside resources prior to requesting aid.

Fellowships. A number of fellowships are available to incoming students. Fellowships are awarded on the basis of academic achievement, test scores, extracurricular activities, and professional achievement. Fellowships are awarded for two years of graduate study. Requests for fellowships should be filed no later than 1 March to receive full consideration. A number of awards are reserved for outstanding applicants whose applications are filed after 1 March.

Limited fellowships are available to second-year students based on their overall performance and contribution to the program during their first year of study.

Loans. The Business School Loan Fund, which is a part of the Federally Insured Student Loan Program, consists of 7 percent interest loans. Students who demonstrate need, according to federal guidelines and information supplied on a Graduate and Professional School Financial Aid Service (GAPSFAS) form, will qualify for interest subsidies. The above loan may be applied for through the Financial Aid Office of the Duke Business School. The Duke Federally Insured Student Loan (FISL) program is comparable to FISL programs offered by various state agencies and banks. Students are encouraged to inquire about the FISL programs in their home states as some offer compensation to state residents. In addition, if a student has previously borrowed from a state agency or bank, this program should be continued in order to ease loan repayment.

College Work-Study Program. The College Work-Study program is a federally funded program supporting the employment of students. Under this program, a student's salary is paid jointly by the federal government and the campus employer. Students must meet federal need standards to qualify. If a student is given a work-study allocation, it is the individual's responsibility to find employment either within the Business School or elsewhere on campus.

Financial Aid Application. Financial aid decisions are made as applications are completed, with the first awards being granted about 15 March. All students applying for financial aid must complete the Financial Aid Request section of the admissions application and a GAPSFAS form. The GAPSFAS application may be obtained from the Graduate and Professional School Financial Aid Service, Box 2614, Princeton, New Jersey 08540, and should be filed no later than 1 February, in order to ensure its arrival at Duke by 1 March. It contains sections to be completed by the applicant, by the spouse or spouse-to-be, and by the applicant's parents. Applicants who have been claimed as dependents by their parents in the previous year or who will not be considered independent by federal standards must have the parents' questionnaire section completed.

Career Counseling and Placement



Career Counseling and Placement Office

The Business School maintains a Career Counseling and Placement Office exclusively for the use of M.B.A. candidates and alumni. Students who register with the office are offered the opportunity to assemble a complete dossier of academic records and recommendations to supplement applications for employment and to establish a permanent file for future use. The office maintains an up-to-date library of employer career information and houses private interview facilities. Interviews are scheduled throughout the year for students registered with the office. This office arranges informal student-employer sessions for firms visiting the campus who wish to make preinterview presentations. The director of career counseling and placement is available to talk with students about their individual plans, goals, and career opportunities.

Career Planning Seminar. The placement office conducts a career planning seminar which is open to all students of the school. The seminar focuses on resume preparation, effective interviewing techniques, business etiquette, and appropriate business attire. Guest speakers from various career fields are featured.

Resumes. The placement office coordinates preparation of individual student resumes by providing typing and reproduction services. Each student receives a supply of resumes for his or her personal use. Student resumes are collected and published in a composite resume book which is distributed to several hundred potential employers.

Career Alternative Workshops. The placement office, in cooperation with the M.B.A. Association, sponsors a series of career alternative workshops for first-year students. These workshops feature professionals from various fields including commercial and investment banking, public accounting, management consulting, finance, marketing, and operations management.

Professional Affiliations. The placement director is a member of the College Placement Council (CPC), the Middle Atlantic Placement Association (MAPA), and the Southern College Placement Association (SCPA), and regularly attends their meetings to stay abreast of recent developments in the placement field as well as maintain contact with regional and national employers. The placement office participates in the nationwide CPC Salary Survey which is a major source of comparative salary data for career planning.



Employment Offers

The class of 1978 enjoyed a fine year in terms of meaningful employment, multiple job offers, and attractive salaries. The class averaged about three job offers per student. The following is a partial list of firms that extended offers of employment to the M.B.A. class of 1978:

- Aetna Life & Casualty Co., Inc.
- American Hospital Supply Corp.
- American Management Systems
- American Restaurant Corp.
- Arthur Andersen & Co.
- Arthur Young & Co.
- Ashland Oil, Inc.
- AT&T (Long Lines)
- Bache Halsey
- Benton & Bowles
- Brown & Williamson Tobacco Corp.
- Burroughs Corp.
- Carolina Power & Light
- Chemical Bank

Chubb Group of Insurance Cos.
Citizens & Southern National Bank
Comshare
Cooper Group
Coopers & Lybrand
Dankim Enterprises
Datapoint
Deloitte Haskins & Sells
Deere & Co.
Diamond Shamrock Corp.
Eli Lilly & Co.
Equitable Trust Co.
Ernst & Ernst
Fairchild Industries, Inc.
First National Bank of Chicago
First National Holding Corporation of Atlanta
First Union National Bank
Ford Motor Company
General Electric Credit Corp.
General Telephone Company of California
General Telephone Company of Iran
General Telephone Company of the Southwest
Gould Inc.
William E. Hill & Company, Inc.
IBM Corp.
Inland Steel Co.
Kappa Systems
Kendall Co.
Matthews Young & Associates, Inc.
Mellon Bank N.A.
Metropolitan Life Insurance Co.
Milliken & Co.
NCR Corp.
Needham, Harper, & Steers
The Nicholas Agency
North Carolina National Bank
North Carolina Science and Technology Research Center
Northern Trust Co.
Norton Co.
Peat, Marwick, Mitchell & Co.
Pittsburgh National Bank
Price Waterhouse & Co.
Procter & Gamble Co.
RCA Corp.
Service Bureau
Sheridan Sales
Touche Ross & Co.
Wendy's
Werner Spitz Construction Co.
Westvaco
Weyerhaeuser Co.
F. W. Woolworth Co.
Xerox Corp.

Student Life



Living Accommodations

Duke University offers varied living accommodations to married and single graduate students. A brief description of each follows.

Trent Drive Hall. Only limited space in one residence hall is presently available for single students in the graduate and professional schools. This facility is adequate and convenient; however, there are some disadvantages such as the lack of single rooms and private baths.

Trent Drive Hall, located near the Duke Medical Center, houses a limited number of graduate and professional school students, both men and women; the upper floors house undergraduates. Commons areas on the main floor and dining facilities on the ground floor are shared by all students who live in the house.

The limited number of single rooms are usually reserved by previous occupants for the following academic year. Other rooms are equipped for two persons.

Town House Apartments. Town House Apartments, located in the Central Campus area, is a thirty-two-unit complex, which also houses graduate and professional school students. These apartments are more spacious than the apartments found on campus or in Durham. Because of its location away from the academic facilities of the three campuses, students find that these apartments offer a change from normal campus life and activities. They are available for continuous occupancy, summer months included.

Some two-bedroom apartments are furnished for two single graduate students. The remaining apartments are furnished for three students. In each apartment for three students, choice of the single bedroom is determined by the occupants.

Each air-conditioned apartment includes a living room, master bedroom, one and one-half baths, a single bedroom, and an all-electric kitchen with a dining area. Spacious closets and storage spaces are provided within each apartment.

Occupants must make arrangements and pay for electricity, gas, and telephone service with the local utility companies. These companies usually require a deposit when initial applications for service are made.

Central Campus Apartments. During 1975, Duke University completed a 500-unit apartment complex. These units are available throughout the calendar year for continuous occupancy.

Apartments will be available for single and married students attending the graduate and professional schools and undergraduate colleges as well as all

categories of students receiving instruction in the Allied Health Division of the Medical Center.

For single graduate and professional school students, one-bedroom and three-bedroom apartments are fully furnished; a few furnished efficiencies are also available. It is expected that many more applications will be received for efficiencies than can be accommodated.

Application Procedure. The Department of Housing Management provides students accepted to the University with housing application forms and detailed information on rates, rental agreements, and availability of housing. A completed and returned application form, accompanied by the required \$50 residential deposit, is necessary to be considered for assignment. Applications will be processed on a first-apply, first-assigned basis.

Food Services

West Campus and Trent Drive Hall. The dining facilities on West Campus include two cafeterias with multiple-choice menus. The Oak Room has waitress service and offers full meals and a la carte items. The Cambridge Inn, a self-service snack bar open throughout the day and evening, is located in the West Campus Union. Trent Drive Hall has a public cafeteria and a snack bar, Gradel's, which is open until midnight.

East Campus. On the East Campus there are two dining halls which serve cafeteria-style meals. Although designed to serve residents on East Campus board plans, all other students may purchase meals there at the guest rate. Because of the large number of students served in the dining halls, it is not possible to provide special diets.

The cost of meals to nonboard students approximates \$3 to \$4 per day, depending on the needs and tastes of the individual.

Student Activities

Office of Student Services. The purpose of the Office of Student Services is to increase the effectiveness of student administration and nonacademic advising. The office is responsible for information about student employment, financial aid policies and programs, and Graduate School of Business Administration alumni communications. Student services also works with the M.B.A. Student Association coordinating other student activities and needs.

M.B.A. Student Association. Membership in the M.B.A. Student Association is automatic and does not require the payment of dues. The association acts as a liaison between the students and faculty and administration in both academic and nonacademic matters. The structure of the association includes several standing and ad hoc committees dealing with concerns such as admissions and placement, computer and library facilities, intramural sports participation, and social events.

Cocurricular and Recreational Activities. Graduate students at Duke University are welcome to use recreation facilities and to affiliate with choral, dance, drama, music, and religious groups. They may become junior members of the American Association of University Professors and may affiliate with Phi Beta Kappa and social fraternities. Graduate women and wives of graduate students may join the Graduate Women's Club.

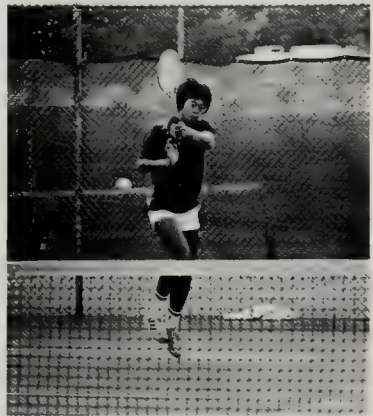
A full program of cocurricular and recreational activities is presented by the Associated Students of Duke University, Cultural Affairs Office, Duke University Christian Council, Duke University Union, Student Activities Office, Y.M.C.A.,

Y.W.C.A., and recreational clubs. Most programs are open to the entire University community. Inquiries should be directed to the ASDU Office; the Duke Chapel; the Office of Cultural Affairs, 107 Page Building; the Duke University Union, 207 Flowers Building; or the Student Activities Office, 204 Flowers Building.

The Information Center, Page Box Office, publications offices, art gallery, meeting rooms, lounges, and recreational facilities are located in the Flowers and Union Buildings.

Full information regarding the scheduling of major events and programs for the entire year will be found in the Duke University annual *Calendar*; detailed and updated information in the weekly *Calendar*, available on each Friday; and the *Duke Chronicle*, available each Monday through Friday.

Intramural and Recreational Sports. The Duke recreational and intramural programs provide all students with an opportunity to participate in some form of informal and competitive physical activity.



The men's program consists of seventeen different activities which include archery, bowling, cross country, golf, handball, horseshoes, tennis, flag football, badminton, raquetball, basketball, swimming, table tennis, volleyball, wrestling, softball, and track. In a typical year more than 3,000 students compete for the many intramural titles and trophies that are awarded. Each year Duke, North Carolina, North Carolina State, and Wake Forest meet in the annual Big Four Intramural Day.

The women's program encompasses competition in badminton, basketball, bowling, tennis, and volleyball. In addition, various clubs including modern dance, water ballet, and other sports offer the student opportunities to take part in extracurricular activities.

Through coeducational intramurals, the student is encouraged to participate on a less competitive level promoting relaxed social as well as physical activity. There is coeducational competition in badminton, table tennis, tennis, and volleyball. Numerous other activities are being planned so that women will have opportunities similar to those available for men.

The University's varied athletic and recreational facilities and equipment are available for use by the students. The facilities for recreation include a golf course, lighted tennis courts, three swimming pools, a student activities building, three gymnasias, outdoor handball and basketball courts, an all-weather track, and numerous playing fields and informal recreational areas. A variety of clubs dealing with archery, gymnastics, scuba diving, sailing, cycling, badminton, karate, rugby, soccer, and other activities are available to interested students.

Services Available

Counseling and Psychological Services. The University provides a professional counseling service designed to aid students in gaining a better understanding of themselves and the opportunities available to them. Counseling is available in the areas of career planning, educational opportunities, and personal and social adjustment.

The center maintains files of educational and vocational information related to career planning, graduate educational programs and fellowships, and study aids.

National and University-wide testing programs are administered by the center. The staff conducts continuing research in counseling and testing.

Medical Care. The aim of the University Health Service is to provide any medical care and health advice necessary to the student as a member of the University community. The health service maintains the University Health Services Clinic located in the Pickens Building on West Campus and the University infirmary on the East Campus. Emergency transportation can be obtained from the Duke Public Safety Office. A separate fee for the University Health Service is assessed.

The Student Health Service offers varied benefits. To secure them, full-time graduate students must be in residence; during the fall and spring semesters, they must be registered for at least 9 units per semester until they have passed the doctoral preliminary examination. After the preliminary examination is passed, they must be registered for at least 3 units in residence. In the summer session, a student must be registered for at least 1 unit of research or 3 units of course work.

The University Health Services Clinic offers the student outpatient services, routine laboratory and X-ray examinations in the clinic for the treatment of acute illness or injury, and advice and assistance in arranging consultation for medical treatments. Fees for such consultations or treatments must be paid by a student who is not covered by an insurance plan.

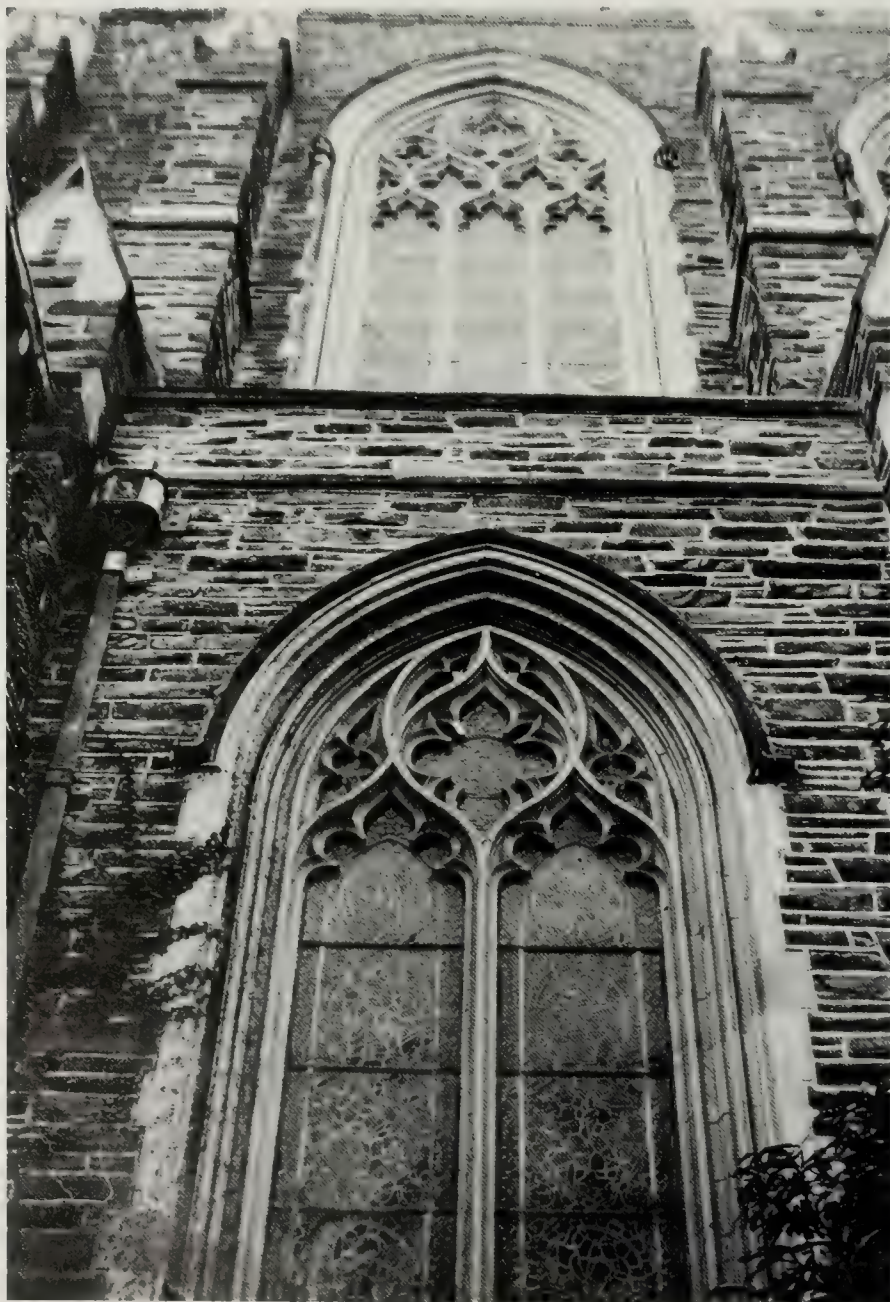
The facilities of the University infirmary are available to all currently enrolled full-time students in residence during the regular academic year. Hospitalization in the University infirmary is provided for treatment of acute illness or injury as authorized by a physician in the University Health Services Clinic. Students are required to pay for their meals while confined to the infirmary.

The Student Mental Health Service, located in the University Infirmary Building, East Campus, provides evaluations and brief counseling and/or treatment of matters ranging from questions about normal growth and development to the most serious psychiatric disorders. A student may have up to four appointments per year with the Student Mental Health Service at no charge. Further interviews can be arranged, either with this staff or with other professionals, at a fee commensurate with the student's ability to pay.

The resources of the Duke University Medical Center are available to all Duke students and their spouses and children, although any bills incurred at Duke Hospital or any other hospital are the responsibility of the student, if not covered by an insurance plan. The Student Health Program does not provide health care for spouses and dependent children of married students. Coverage of the married student's family is provided in the University's Student Accident and Sickness Insurance Plan for an additional fee.

The University has made arrangements for a Student Accident and Sickness Insurance Plan to cover all full-time students for a twelve-month period. For additional fees a student may obtain coverage for a spouse and a child. Although participation in this program is voluntary, the University requires all graduate students to be financially responsible for medical expenses above those covered by the University Student Health Program through the University Accident and Sickness Policy, a private policy, or personal financial resources. Students who have equivalent medical insurance or wish to accept the financial responsibility for any medical expense may elect not to take the Duke plan by signing a statement to this effect. *Each full-time student in residence must purchase this student health insurance or indicate the alternative arrangement.* The Student Accident and Sickness Insurance Policy provides protection twenty-four hours per day during the full twelve-month term of the policy for each student insured. Students are covered on and off campus, at home, while traveling between home and school, and during interim vacation periods. The term of the policy is from the opening day of school in the fall. Coverage and services are subject to change each year as deemed necessary by the University.

Academic Procedures and Information



Registration

All students who are enrolled in the Graduate School of Business Administration must register each semester until all degree requirements are completed. After receiving notification of admission to the school and returning a statement of acceptance of admission, the student must register for the term indicated in the admission letter. New matriculants register during orientation week at the designated times. Each student must complete a course card listing the course work to be taken during the semester and then obtain the approval signature from the appropriate program director. The student then presents this course card to registration officials for enrollment in the selected courses. After the first registration, a student must register for subsequent semesters at the regular stated time for registration. Currently enrolled students who fail to register at the first scheduled registration period for the subsequent semester incur a penalty for late registration.

Late Registration. All students are expected to register at the times specified by the University. A late registration fee of \$25 is charged any student registering late, including a current student who delays registering until the special registration for new students.

Change of Registration. During the first *two weeks* of the semester, registration may be changed with the approval of the program director, if no reduction of fee is entailed. If fees are to be refunded, the approval of the dean of the Business School is required.

Academic Requirements for the M.B.A. Program

Grading. The grading scale for M.B.A. students is: *A*—superior; *B*—high pass; *C*—pass; *D*—low pass; and *F*—fail.

Continuation Requirements. An M.B.A. student may proceed to the second year of the program only by completing all first-year courses and by receiving grades of *C* or better in at least 24 units of first-year course work.

Students in concurrent degree programs must meet continuation requirements in the cooperating department or school as well as the above.

Graduation Requirements. An M.B.A. student may be graduated only by completing all course requirements and by receiving grades of *C* or better in at least 24 units of second-year course work.

Exemptions. Students seeking an exemption from any curricular requirement or other requirement of the Graduate School of Business Administration must submit a formal request to the assistant dean for student affairs.

Standards of Conduct. Duke University expects and will require of all its students continuing loyal cooperation in developing and maintaining high standards of scholarship and conduct. The University wishes to emphasize its policy that all students are subject to the rules and regulations of the University currently in effect or which are put into effect from time to time by the appropriate authorities of the University.

Any student in accepting admission indicates a willingness to subscribe to, and be governed by, these rules and regulations and acknowledges the right of the University to take such disciplinary action, including suspension and/or expulsion, as may be deemed appropriate, for failure to abide by such rules and regulations or for conduct adjudged unsatisfactory or detrimental to the University.

Commencement

Graduation exercises are held once a year in May. At this time degrees are conferred and diplomas are issued to those who have completed requirements by the end of the spring semester.

Those who complete degree requirements at the end of the fall semester or by the end of a summer term receive diplomas dated 30 December or 1 September, respectively. There is a delay of about one month in the mailing of September and December diplomas because diplomas cannot be issued until they are approved by the Academic Council and the Board of Trustees.



Other Information

Student Records. Duke University adheres to a policy permitting students access to their student records, with the exception of confidential letters of recommendation received prior to 1 January 1975, and certain confidential financial information. Students may request review of any information which is contained in their student records and may challenge the content of their records by appropriate procedures. An explanation of the complete policy on student records may be obtained from the associate registrar.

No information contained in student records (academic or otherwise) is released to persons outside the University or to unauthorized persons on the campus, without the consent of the student. A student grants consent by signing a form which authorizes the release of data. Specific consent is required for the release of information to any person or organization outside the University, and it is the responsibility of the student to provide the necessary authorization and consent.

Reciprocal Agreements with Neighboring Universities. Under a plan of cooperation between Duke University and the University of North Carolina at Chapel Hill, North Carolina Central University in Durham, and North Carolina State University at Raleigh, students properly enrolled in the Graduate School of Business Administration during the regular academic year, and paying full fees to this institution, may be admitted to a maximum of two courses per semester at one of the other institutions in the cooperative plan. Under the same arrangements, students in the graduate schools in the neighboring institutions may be admitted to course work at Duke University. All interinstitutional registrations involving extra-fee courses or special fees required of all students will be made at the expense of the student and will not be considered a part of the Duke University tuition coverage.

Identification Cards. Graduate students are issued two-part identification cards which they should carry at all times. The cards are the means of identification for library privileges, athletic events, and other University functions or services open to them as University students. Students will be expected to present their cards on request to any University official or employee. The cards are not transferable, and fraudulent use may result in loss of student privileges or suspension. A student should report the loss of a card immediately to the registrar's office. The cost of a new identification card is \$5.

Courses of Instruction



Master of Business Administration

300. Managerial Economics. Considers how the actions of business firms, consumers, and the government—operating within a price system in a decentralized market economy—answer such basic resource allocation questions as what will be produced, how will it be produced, who will consume what is produced, and what resources to divert from present consumption to increase future consumption. The impact of various types of market structures (such as perfect competition, monopoly, and oligopoly) on economic efficiency will be discussed. Provides the student with an ability to view resource allocation problems within a constrained optimization framework and with some practice in applying marginal analysis. 3 units.

301. Economic Environment of the Firm. Develops the theoretical framework within which the determinants of economic aggregates such as gross national product, the rate of unemployment, and changes in price levels can be analyzed. The emphasis of the course is to provide the manager with the knowledge necessary for making and understanding forecasts of the macroeconomic environment. Both Keynesian and monetarist approaches are considered. 1½ units.

302. The Economics of Government Policy Toward Business. Provides the student with an understanding of how the firm interacts with other institutions in the economic environment. By examining both the theoretical and institutional framework of regulation, antitrust activities, and labor unions, the prospective manager will be better prepared to interact with noncorporate organizations. In addition, the course seeks to examine the role of the firm in the economy and the way in which it carries out its activities. Prerequisite: second-year standing in the M.B.A. program or consent of instructor. 3 units.

303. Current Problems in Macroeconomics. Major issues and problems confronting macroeconomic policy-makers are analyzed. Included among the topics covered are inflation, economic growth, unemployment, and the choice of appropriate policies for economic stabilization. The emphasis of the course is in applying basic macroeconomic theory to actual problems to better understand the motivation behind economic policy. Extended policy cases are used as a basis for class discussions and individual student assignments. Prerequisite: second-year standing in the M.B.A. program or consent of instructor. 3 units.

311. Statistical Analysis for Management. Examines structures for managerial decision-making under conditions of partial information and uncertainty.

After developing a foundation in probability theory, the course extends this foundation to a set of structures and methodologies for the analysis of decision problems. Included are topics in probability, classical inference, and multivariate analysis. 3 units.

312. Quantitative Analysis for Management. Examines the principles and techniques of building quantitative models to aid managerial decision-making. Special emphasis is placed on utilizing models for structuring and analyzing resource allocation problems and decision problems under uncertainty. Topics include linear programming, decision analysis, and simulation. 3 units.

313. Operations Research Applications. Deals with problems of organization for an operations research project, formulation of the problem, model construction, interpretation of analytical results, and implementation. Selected cases of particular applications of operations research from the literature serve as a basis for much of the class work. Students work in local industry, the University, the Medical Center, or in other cooperating agencies on operations research problems. Methodologically, some attention is devoted to advanced solution techniques as necessary to complete student projects, but primary attention is focused on formulation and use of models, the modification of existing models, or the development of new ones. Prerequisite: second-year standing in the M.B.A. program or consent of instructor. 3 units.

314. Operations Research Methods. This course surveys the methodologies of operations research and shows how they can be applied to decision-making situations. The course will be primarily concerned with selecting which tool to use in various situations, rather than algorithm details. Topics to be covered include: dynamic programming, stochastic programming, integer programming, nonlinear programming, Markov chains, inventory theory, and linear model formulation. Prerequisite: second-year standing in the M.B.A. program or consent of instructor. 3 units.

315. Operations Research in Public Policy Analysis. Deals with the use of formal operations research models in the analysis of public policy. Emphasizes the basic structuring of policy problems as well as the use of standard operations research models in the analysis. Included in the course studies, a class project, and, where necessary, the development of specific models. Prerequisite: second-year standing in the M.B.A. program or consent of instructor. 3 units.

318. Computer Skills. Emphasizes the use of the computer for support of the decision-making process. Introduces computer technology, hardware, software, use of computer systems, library programs, and a computer programming language. Noncredit.

320. Organization Behavior. Provides a study of organizations and their environment and the social and psychological foundations necessary to understand the behavior of individuals within organized settings. Emphasis is given to managerial strategies which enhance organizational effectiveness. Topics include individual and small group behavior, goal setting and adaptation, organization structure, and leadership. 3 units.

321. Organization Design. Examines the strategic factors available to managers in posturing, structuring, and controlling their organizations to achieve objectives in a dynamic environment. Topics include the evaluation of organization designs, frameworks for organization design, the measurement of system performance, and the problems and tradeoffs in designing adaptive systems. 1½ units.

322. Organizations and Their Environment. Examines current knowledge about organizations and their environment and the interdependencies between them. The focus of the course will be on the organization's perception of its environment and on managerial strategies for controlling or adapting to environmental uncertainties. Prerequisite: second-year standing in the M.B.A. program or consent of instructor. 3 units.

323. Organization Innovation and Change. Reviews planned approaches to organization change. Topics include structural, technological, and behavioral approaches to change, models of change, intervention methods, change agent behavior, and measurement of change. Processes of innovation and change in business organizations are presented. Theories of creativity, technological innovation, and organizational change are considered in terms of their implications for managerial action. Prerequisite: second-year standing in the M.B.A. program or consent of instructor. 3 units.

324. Personnel Administration. Considers organization alternatives and strategies for attracting, training, developing, and maintaining a viable work force. Various methods available to contemporary managers for anticipating and coping with human behavior will be examined. The impact of the federal government in terms of legislation and executive orders which constrain managerial discretion and the role of organized labor and union/management relations are also considered. Prerequisite: second-year standing in the M.B.A. program or consent of instructor. 3 units.

325. Leadership of Formal Organizations. Explores in some detail what is known and not known about leadership of organizations, and helps prospective managers learn to think about their leadership behavior. The course will analyze current leadership theories, probe the nature of managerial work, and examine some of the primary roles leaders have to play in organizations. Class members will take and receive feedback on a number of leadership questionnaires, participate as managers in an organizational simulation, and examine their vocational interests as they relate to managerial work. Prerequisite: second-year standing in the M.B.A. program or consent of instructor. 3 units.

326. Current Problems in Personnel Planning. Studies various issues in personnel management on a seminar basis. These include aggregate personnel planning as an integrated element of the firm's strategic planning process and personnel administration. The seminar emphasizes both formal models and organization structure. Current issues in manpower planning techniques, personnel data systems, impact of technology changes, research into techniques for identifying managerial potential, new concepts in training and development, career planning, and significance of changing attitudes toward work are discussed. Prerequisite: second-year standing in the M.B.A. program or consent of instructor. 3 units.

330. Financial Accounting. Introduces the student to the types of information requirements imposed on the firm by agencies in its environment and develops an understanding of the activities of the firm within the framework of a financial accounting system designed to satisfy these information requirements. Emphasis is given to the study of financial accounting, reporting, and measurement problems from a theoretical and an applied basis, using cases and topical problems in financial accounting as a foundation for the learning experience. 3 units.

331. Managerial Accounting. Establishes the relationships between the strategies of the firm as reflected in its planning activities and the impact of those



plans on the data gathering, reporting activities, and operations inside the firm. Specific topics include budgeting, standard costing, control in a programmed environment, capital budgeting, and funds analysis. 3 units.

332. Accounting for Not-for-Profit Organizations. Studies the information needs and principles of measurement of activities of organizations whose goals are specified in terms other than profit maximization. Prerequisite: second-year standing in the M.B.A. program or consent of instructor. 3 units.

333. Management Planning and Control Systems. Examines recent developments in the area of management planning and control systems. The emphasis is placed on the development and use of information for these systems, and the behavioral consequences of various approaches to performance evaluation. The role of management accounting in planning and control systems is stressed. Prerequisite: second-year standing in the M.B.A. program or consent of instructor. 3 units.

334. Corporate Financial Reporting. Focuses on significant issues of interest to users of publicly available accounting information, including financial statements. Issues of current interest in the valuation of assets and liabilities and income determination are considered. Emphasis is placed on the effects of alternative accounting measurement and reporting procedures on users' decision models. Prerequisite: second-year standing in the M.B.A. program or consent of instructor. 3 units.

335. Management Information and Control Systems. Focuses on the set of problems associated with the design and operation of the information systems necessary to support strategic planning of an organization and to support the organization's control system. Specific attention is given to the role of information in planning and control, the economics of information, the dynamics of information flows, technologies of information systems, information system design, data base construction and maintenance, and reporting systems. Prerequisite: second-year standing in the M.B.A. program or consent of instructor. 3 units.

336. Internal Control, Auditing, and Information Systems Analysis. Studies the techniques available to evaluate the reliability of an existing information system. An evaluation is made of information flows, aggregation techniques and other topics necessary to evaluate the credibility of information reported from a particular data gathering system. Topics include audit objectives from an internal and external standpoint, cost of information, standards, and other topics relevant to both internal and external auditing problems. Prerequisite: second-year standing in the M.B.A. program or consent of instructor. 3 units.

337. Accounting for Complex Corporate Organizations. Introduces and examines the problems of accounting for and reporting of the diverse activities of multiproduct, multidivisional, multinational organizations including accounting for business combinations and intercompany relationships. Prerequisite: second-year M.B.A. standing or consent of instructor. 3 units.

340. The Management Experience. Enables the student to apply the skills obtained in earlier courses to problems of operating and managing a business enterprise. Student teams are responsible for the management of firms in a computerized simulation which duplicates the characteristics of a large, consumer-oriented industry. Decisions must be made concerning production, labor utilization, market research, advertising, allocation of sales force, financial operations, accounting, production scheduling and maintenance, procurement, and personnel. Each firm reports periodically to a board of directors composed of faculty and executives from the local business community. 3 units.

341. Corporate Strategy and Public Policy. Examines the major phases of the strategic planning process in business firms and with the manner in which business firms can affect public policy. Considerations involving the various functional areas of management are synthesized to permit senior executives to make meaningful decisions concerning the product-market posture of the firm. Examples of the topics covered include: formulation of goals, analysis of the external environment, bottom-up and top-down planning, coordination and control, management objectives and responsibilities, and the role of business firms in influencing public policy. 3 units.

342. The Firm in the Public Policy Process. Reviews the sources, direction, and process of government social initiatives as they affect business; the causes of public distrust and hostility toward business; social stereotypes of business; the process of policy-making. Cases of effective and ineffective participation in the public policy process are developed with specific emphasis on problems of political feasibility, internal organization, and future social issues that business should be aware of. Prerequisite: second-year standing in the M.B.A. program or consent of instructor. 3 units.

343. Tax Factors in Business Decisions. A study of the federal income tax laws related to the determination of taxable income and the development of new laws to achieve social, economic, and administrative objectives and an examination

of the tax laws on business decisions. Prerequisite: second-year standing in the M.B.A. program or consent of instructor. 3 units.

345. Legal Environment of the Firm. Considers the legal environment of the firm with emphasis on the legal system, the process by which laws are formulated and changed, and the type and forms of legal constraints imposed on firms. Also examined are major legislation, court cases, and regulation by federal agencies which affect the firm's decisions. Prerequisite: second-year standing in the M.B.A. program or consent of the instructor. 3 units.

346. Analytical Approaches to Corporate Strategy and Public Policy. Develops structured frameworks for viewing the various problems inherent in the process of formulating, implementing, and monitoring both internal and external aspects of strategy in modern business firms. Relevant considerations in the strategic planning process and the influencing of public policy are identified, and the manner in which form models and data bases can prove useful to executives in dealing with various subproblems is discussed. Real world cases will be used to discuss such topics as: the nature of formal planning systems, uses and limitation of management science models, available data bases, sources of information for environmental analyses, and methodologies for public policy analyses. Corequisite: Business Administration 341. 3 units.

350. Financial Management. Focuses on the acquisition of financial resources from the external market and their effective utilization and control within the organization. Specific attention is given to capital markets, evaluation of the firm, short-run resource planning (cash, inventory, receivables, and short and intermediate-term financing), and long-run resource planning (investment in long-lived assets, leasing, debt and equity financing, dividend policy, and the cost of capital). Institutional aspects of financial markets are emphasized only to the extent that they provide necessary insights into the problems of planning financial strategy. 3 units.

351. Short-Run Financial Management. Examines the financial management and control of a firm's short-term assets and liabilities. Topics include cash management, management of the firm's short-term investment/borrowing portfolio, receivables management, and management of the firm's bank relationships. Prerequisite: second-year standing in the M.B.A. program or consent of instructor. 3 units.

352. Long-Term Financial Management. Deals with the long-term financing and investment decisions of the firm. Special attention will be given to the valuation of corporate securities, capital structure theory and policy, capital budgeting, corporate planning models, and analysis of the firm's cost of capital. Prerequisite: second-year standing in the M.B.A. program or consent of instructor. 3 units.

353. Money and Capital Markets. Considers the structure and behavior of capital markets. The course includes a discussion of the institutional framework of the American capital market as well as the major international markets, although the emphasis is on the theoretical foundation for analyzing interest rates and funds flow in those financial markets. Included among the topics is an extended discussion of monetary theory, the term structure of interest rates, and the analysis of risk in financial markets. Prerequisite: second-year standing in the M.B.A. program or consent of instructor. 3 units.

354. Investment Analysis and Portfolio Management. Focuses on the problems of selecting individual security issues for investment and the construction, management, and performance evaluation of portfolios. Topics that are covered

include the structure and operations of securities markets, the behavior of security prices, the analysis and valuation of various types of securities, and the implementation of portfolio and capital market frameworks and tools for analysis. Prerequisite: second-year standing in the M.B.A. program or consent of instructor. 3 units.

355. Management of Financial Institutions. Explores various ways in which management science techniques can be applied to the management problems of financial institutions, especially commercial banks. The course will examine several types of financial institutions, consider the role that they play in the American economy, and focus on the use of management science techniques for helping executives cope with planning, decision-making, and control problems. Prerequisite: second-year standing in the M.B.A. program or consent of instructor. 3 units.

358. Special Topics in Finance. Treats specific advanced topics in finance. Topics vary depending on the interests of students and the instructor, but will be identified in advance. Discussions are based on assigned readings and individual or group research papers. A term project is normally required. Prerequisite: second-year standing in the M.B.A. program or consent of instructor. 3 units.

360. Marketing Management. Provides an overview of the marketing function in business firms. By acquainting students with the fundamental issues and decisions involved in planning and managing marketing activities. Attention is given to the strategic marketing decisions of new product development, product policy, pricing, advertising and communications, marketing research, personal selling, and channels of distribution. Major emphasis is placed on developing an understanding of the underlying forces which influence marketing decisions, including buyer behavior, competitive marketing activity, organizational considerations, and governmental regulation. 3 units.

361. Advanced Marketing Strategy. Considers in greater depth the process of strategic planning in the marketing function and its relation to corporate strategy. Offers an opportunity to sharpen and extend analytical skills in marketing as well as to synthesize understanding of the managerial, organizational, and environmental aspects of marketing activity. Prerequisite: second-year standing in the M.B.A. program or consent of instructor. 3 units.

362. Marketing Research. Considers the process of identifying and generating information from research as input to marketing decision making. Emphasis given to the perspective of the marketing manager in determining whether additional information is needed and, if so, how appropriate information should be acquired. Topics include problem definition, research budgeting, research designs, (survey, observational, experimental), sampling, methods of data collection, data analysis, and interpretation. Prerequisite: second-year standing in the M.B.A. program or consent of instructor. 3 units.

363. Consumer and Buyer Behavior. Provides an opportunity for advanced study of the behavior of buyers of consumer and industrial goods/services. Objectives include (1) increasing the prospective manager's sensitivity to and understanding of buyers and the psychological, sociological, and anthropological forces which shape their behavior, and (2) enabling the student to apply this knowledge in arriving at improved marketing decisions. Prerequisite: second-year standing in the M.B.A. program or consent of instructor. 3 units.

364. Advertising Management. Deals with issues and problems in planning and controlling advertising activities in the firm, largely from the perspective of product managers and general marketing managers who must develop strategies for communicating with customers and other important publics of the firm.

Attention is devoted to the setting of advertising objectives, budget appropriation, copy/message strategy, media strategy, advertising research and evaluation, and government regulation. Emphasis is placed upon behavioral analysis of target audience utilizing social-psychological and communication theories. Prerequisite: second-year standing in the M.B.A. program or consent of instructor. 3 units.

365. Product Management. Develops further insights into the process and policies which guide the firm's offering of products to the market place. Topics include the problem of merging market needs with corporate resources; product concept and positioning; systematic approaches to new produce development; branding; packaging; product abandonment. The basic point of view is strategic in that product decisions are an integral part of overall marketing strategy decisions. Interfunctional management aspects are also considered. Prerequisite: second-year standing in the M.B.A. program or consent of instructor. 3 units.

370. Operations Management. Examines problems associated with the design, operation, and control of the transformation processes utilized by an organization in producing goods and services for its external markets. Specific attention is given to system design (product design, process design, capacity planning), system operation (production planning, scheduling) and system control (inventory control, quality control). 3 units.

371. Logistics Management. Focuses on the characteristics, analysis, and integration of logistical system elements. The major elements include: transportation, materials management, and physical distribution. The course will examine (1)



the economic characteristics and government regulations of rail, motor, water, air, and pipeline carriers, and (2) how these three elements effect the production and marketing functions in terms of cost and customer service. Prerequisite: Second-year standing in the M.B.A. program or consent of instructor. 3 units.

372. Scheduling Models and Problems. Studies problems involving the allocation of resources over time. The major elements, relationships, and criteria in scheduling problems are examined, along with useful models for structuring and analyzing such problems. Solution methods, typically utilizing the power of the computer, are studied in detail. Topics include critical path methods, sequencing, job-shop scheduling, and work-force scheduling. Prerequisite: second-year standing in the M.B.A. program or consent of instructor. 3 units.

373. Operations Planning and Control. Examines detailed tactical problems facing operating managers. The emphasis is on specific planning and control problems and on techniques for solving them. Topics include: materials planning and inventory control, aggregate and detailed scheduling, replacement and maintenance, and quality control. Prerequisite: second-year standing in the M.B.A. program or consent of instructor. 3 units.

382. The International Environment. Examines the environment in which multinational firms operate. It includes a discussion of current policy issues such as balance of payments, trade policy, and economic development. Special emphasis is given to the theory of the multinational firm and its role as a participant on the economic scene. That role is evaluated from the perspective of both the firm itself and the countries in which the firm operates. Prerequisite: second-year standing in the M.B.A. program or consent of instructor. 3 units.

383. International Business. Introduces the prospective manager to the set of problems unique to operating in an international environment. The problems are selected from a broad range of functional areas, and include such topics as the life cycle theory of product marketing, plant location, and technology choice for production with labor forces of diverse background. Prerequisite: Business Administration 382. 3 units.

384. International Finance. Provides the background necessary to recognize and analyze the financial problems facing a firm that operates in an international environment. This will be accomplished by developing a theoretical framework which describes the international environment and using that as background, studying specific financial problems related to multinational business. Prerequisite: Business Administration 382. 3 units.

388. Business Communications. Constitutes a program in oral and written communication. It helps students develop the abilities to organize clearly and present effectively both written and oral reports. Noncredit.

390. The Practicum. Gives the student a significant experience in applying the concepts, theories, and methods of analysis learned in the program to a real, complex problem of an economic enterprise. It should include the analysis of a situation and the explicit formulation of a problem. The important task of identifying and specifying the problem is an integral part of the course. The practicum report should propose a solution to the problem and should contain the supporting explanation and logic. The solution should be one that can be implemented, not requiring unavailable resources. 3 units.

391.1-9. Special Topics in Management. Some elective courses may be offered as special topics in management on an occasional basis depending on the availability and interests of students and faculty. 3 units.

Doctor of Philosophy

309.1-.9. Research in Managerial Economics. Credit hours 1-6.

319.1-.9. Research in Quantitative Methods. Credit hours 1-6.

329.1-.9. Research in Organization Theory and Management. Credit hours 1-6.

339.1-.9. Research in Information and Accounting Systems. Credit hours 1-6.

349.1-.9. Research in Public Policy and Social Responsibility. Credit hours 1-6.

359.1-.9. Research in Finance. Credit hours 1-6.

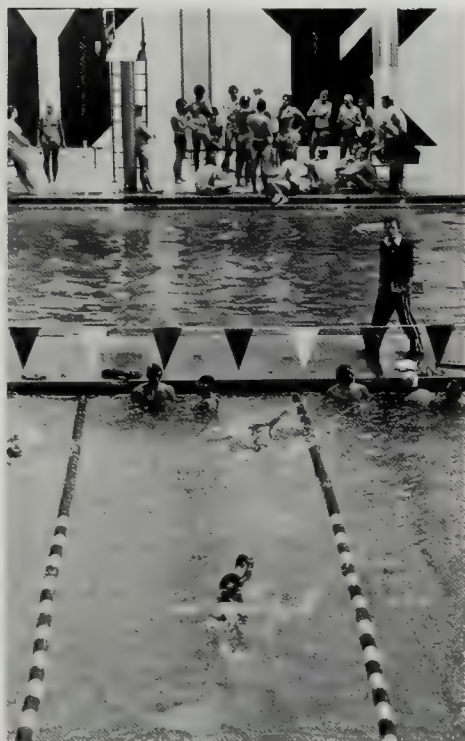
369.1-.9. Research in Marketing. Credit hours 1-6.

379.1-.9. Research in Production. Credit hours 1-6.

392-393. Tutorial in Interdisciplinary Areas. Credit hours 1-6.

397. Dissertation Research.





Appendix



Faculty

The faculty of the Graduate School of Business Administration has a diverse educational and professional background. This diversity provides students with the opportunity to explore wide-ranging aspects of the environment in which they will live and work after completing their educational experience.

The student-faculty ratio in the school is maintained at a level permitting development of close professional relationships and encouraging individual assistance in academic and professional relationships. The student-teaching faculty ratio is about seven to one. In addition, faculty engaged in major research projects and other teaching assignments are available to work with students. This balance is advantageous for both students and faculty in their joint work.

A brief description of the background and main areas of interest of the faculty follows:

Kenneth R. Baker, Ph.D., *Associate Professor of Business Administration*; A.B. (Harvard University), Ph.D. (Cornell University).

Professor Baker's interests include operations management, production planning and control, and operations research. He has written a number of research papers in these areas and is the author of a textbook on scheduling. He previously taught at the University of Michigan and at North Carolina State University.

Helmy H. Baligh, Ph.D., *Professor of Business Administration*; B.A. (Oxford University), M.B.A., Ph.D. (University of California at Berkeley).

Professor Baligh joined the Duke faculty after teaching at the University of Illinois. His major research is in the analysis and design of vertical market structures for both business and social purposes. He has participated in the development of the Master of Business Administration programs at Duke and at the University of Illinois with emphasis on curriculum. Professor Baligh has also served as associate dean of the Graduate School of Business Administration. His publications include *Vertical Market Structures* (with Leon E. Richartz) and several articles in the areas of transportation, hospital administration, and economics. He teaches in the fields of marketing and economic strategies.

Joseph Battle, Ph.D., *Associate Professor of Business Administration*; B.S. (North Carolina Central University), M.S., Ph.D. (University of Michigan).

After serving as special assistant to the president of Shaw University, Professor Battle joined the Duke faculty, teaching in the areas of mathematics, probability and statistics, and economics. Research and consulting interests include the evaluation of federally funded poverty agencies with the Research Triangle Institute and local Durham organizations.

Colin C. Blaydon, Ph.D., *Associate Professor of Business Administration and Policy Sciences*; B.E.E. (University of Virginia), Ph.D. (Harvard University).

Professor Blaydon has taught in the areas of corporate finance, managerial economics, and operations research. He also worked for the Office of Management and Budget in policy formulation

and implementation in pension reform, health manpower, national health insurance, and housing finance. His current research is involved with social security and pension plans.

Richard M. Burton, D.B.A., *Associate Professor of Business Administration*; B.S., M.B.A., D.B.A. (University of Illinois).

Professor Burton's primary research interests are in the design and management of organizations. His research is concerned with the organization of the firm for coordinated operations across the functional areas of marketing, strategy, production, finance, and information systems. He teaches courses in organization design, managerial economics, and management science. Recent consulting experience includes projects for the United States Senate and IBM.

Kalman J. Cohen, Ph.D., *Distinguished Bank Research Professor*; B.A. (Reed College), B. Litt. (Oxford University), M.S., Ph.D. (Carnegie-Mellon University).

Prior to joining the Duke faculty, Professor Cohen served for two years as Distinguished Professor of Finance and Economics and as the first director of the Salomon Brothers Center for the Study of Financial Institutions at New York University. He also spent fourteen years on the faculty of Carnegie-Mellon University's Graduate School of Industrial Administration. He has written six books and over seventy articles in the areas of banking and finance, strategic planning, economics, management science, and computer simulation. He has pioneered in the applications of management science techniques in banking.

David A. Collier, Ph.D., *Assistant Professor of Business Administration*; B.S.M.E., M.B.A. (University of Kentucky), Ph.D. (Ohio State University).

Professor Collier's teaching interests are in production and operations management and logistics. His research interests include the disaggregation processes in both the manufacturing and service sectors, master production scheduling, material requirements planning, and the distribution system and its interface with manufacturing. A large scale simulation model called FACTORY is used to study these research areas.

David C. Dellinger, Ph.D., *Associate Professor of Business Administration*; B.S. (Duke University), M.S., Ph.D. (Stanford University).

Professor Dellinger's current research involves developing cost-effectiveness methodology for evaluating programs of care for the aged. This research is sponsored by the Duke Center for the Study of Aging and Human Development in which he is a senior fellow. He has also done consulting work for the United States Senate Committee on Armed Services dealing with Officer Manpower Management Systems. His teaching fields include operations research and economics, and he has been active in curriculum development with the Duke Master of Business Administration Program.

David A. Dittman, Ph.D., *Associate Professor of Business Administration*; B.B.A. (University of Notre Dame), M.A., Ph.D. (The Ohio State University).

Professor Dittman comes to Duke from Northwestern University where he was a member of the faculty of the Graduate School of Management for five years. His research interests center on the generation, use, and impact of accounting data on management decisions. He teaches managerial accounting and planning and control systems.

Mark R. Eaker, Ph.D., *Assistant Professor of Business Administration and Policy Sciences*; B.S. (Washington and Lee University), A.M., M.B.A., Ph.D. (Stanford University).

Professor Eaker's research and teaching interests are in international finance, macroeconomics, and public policy. Current research deals with the theory of foreign exchange and, in particular, the role of hedgers and speculators in foreign exchange markets.

Jose A. Espejo, Ph.D., *Assistant Professor of Business Administration*; B.A. (Ateneo de Manila University), M.B.A., Ph.D. (Columbia University).

Professor Espejo's principal teaching interests are in the fields of corporate finance, investment management, and international business. His research interests include corporate financing and restructuring policies, credit evaluation techniques, and security risk measurement. He has published in the *Journal of Accounting Research* and has presented papers on convertible debt financing and exchange offers at academic conferences.

John D. Forsyth, D.B.A., *Professor of Business Administration and Director of Executive Development*; B.A. (Queen's University), M.B.A. (University of Detroit), D.B.A. (University of Illinois).

Prior to coming to Duke, Professor Forsyth was professor of business administration and chairman of the program for executive development at IMEDE Management Development Institute in Lausanne, Switzerland. His teaching and research interests are in the areas of financial management, capital expenditure planning, and financing of capital commitments.

W. Clay Hamner, D.B.A., *Professor of Business Administration*, B.B.A., M.A. (University of Georgia), D.B.A. (Indiana University).

Professor Hamner teaches in the areas of organizational behavior, personnel management, and new venture management. He has published over thirty articles in the areas of bargaining strategies, applied motivation theories, equal employment opportunity, and predicting unionization. He has also consulted in these same areas for such companies as Sears, Marathon Oil Company, Clark Equipment, Pepsi, Chemical Bank, and the U.S. Savings Loan League among others. Prior to coming to Duke University, Professor Hamner taught at Indiana University and Northwestern University. At Indiana University he won the Indiana University School of Business Distinguished Teaching Award and the Lieber Memorial Outstanding Teaching Award. Professor Hamner is the coauthor of four text books in the field of organizational behavior and personnel management.

Joel C. Huber, Ph.D., *Associate Professor of Business Administration*, B.A. (Princeton University), M.B.A. (Wharton Graduate Division, University of Pennsylvania), Ph.D. (University of Pennsylvania).

Professor Huber comes to Duke Business School from the Krannert Graduate School of Management, Purdue University. His teaching interests are in the areas of marketing and market research. He is a member of the American Marketing Association, the Association for Consumer Research, and the Psychometric Society.

John S. Hughes, Ph.D., C.P.A., *Associate Professor of Business Administration*; B.S./B.A. (Northeastern University), M.S. (University of Massachusetts), Ph.D. (Purdue University).

Prior to coming to Duke, Professor Hughes spent two years on the faculty of the Amos Tuck School of Business, Dartmouth College. In addition to his primary discipline of accounting, he also has research interests in finance and management science. He is a member of the editorial board of *The Accounting Review*.

Thomas F. Keller, Ph.D., C.P.A., *Dean and R. J. Reynolds Industries Professor of Business Administration*, A.B. (Duke University), M.B.A., Ph.D. (University of Michigan).

Professor Keller specializes in accounting. His current research and teaching interests are principally in the areas of financial accounting and reporting. He has held several offices in the American Accounting Association, including editor of *The Accounting Review* (1972-75). He is the coauthor and coeditor of several books in financial accounting. During the summer and fall of 1975 under the auspices of a Fulbright grant, he lectured in Australia and the Far East on a variety of topics related to the development of accounting theory and standards.

Lawrence Kessler, Ph.D., C.P.A., *Assistant Professor of Business Administration*; B.S. (Lehigh University), M.B.A. (University of California at Berkeley), Ph.D. (University of Texas at Austin).

Professor Kessler teaches in the financial accounting area. His research interests include external reporting issues and the behavioral implications of accounting. His primary research has been in the area of human information processing, judgment, and decision-making.

Dan J. Laughhunn, D.B.A., *Associate Dean and Professor of Business Administration*; B.S. (Engineering Mechanics), M.B.A., D.B.A. (University of Illinois).

Professor Laughhunn has served as a consultant to industry and universities on a variety of topics related to planning and budgeting. His teaching and research interests deal with the application of quantitative techniques to problems in production and finance. Professor Laughhunn also has been actively engaged in teaching executive development programs, both at Duke and at other universities.

Roy J. Lewicki, Ph.D., *Associate Professor of Business Administration*, A.B. (Dartmouth College), Ph.D. (Columbia University).

Professor Lewicki comes to Duke Business School from the Amos Tuck School of Business Administration at Dartmouth College. He teaches organizational behavior and managerial psychology. Professor Lewicki's research includes techniques for the resolution of intergroup conflict, and interpersonal behavior and small group dynamics.

Arie Y. Lewin, Ph.D., *Professor of Business Administration*; B.S., M.S. (University of California at Los Angeles), M.S., Ph.D. (Carnegie-Mellon University).

Prior to coming to Duke, Professor Lewin was on the faculty of New York University for eight years. His research interests have been focused on applications of behavioral science to specific functional areas, organization design, person perception, and business participation in the formulation of public policy. Current research involves person perception of leadership potential and the role of the corporation in the public policy process. Professor Lewin is the coauthor of three books and his papers have appeared in numerous academic journals. Professor Lewin is the organization design department editor of *Management Science*.

Roy M. C. Lourens, Ph.D., *Visiting Professor of Business Administration*, B. Com (University of South Africa), M. Com., Ph.D. (University of Western Australia).

Professor Lourens is on leave from his post as professor of accounting in the School of Commerce at the University of Western Australia in Perth. His research interests are in contemporary professional problems in external reporting and professional responses to social and environmental pressures. He is a chartered accountant in the United Kingdom, South Africa, and Australia and a member of the American Accounting Association.

John M. McCann, Ph.D., *Associate Professor of Business Administration*, B.S.M.E., M.B.A. (University of Kentucky), Ph.D. (Krannert Graduate School of Industrial Administration, Purdue University).

Professor McCann served on the faculty of the Graduate School of Business and Public Administration at Cornell and has been a consultant with an economic modeling and research firm. His teaching interests are in the areas of marketing and econometrics. His current research involves effective communication of energy conservation information to consumers.

Wesley A. Magat, Ph.D., *Assistant Professor of Business Administration*; A.B. (Brown University), M.S., Ph.D. (Northwestern University).

Professor Magat's teaching interests are in managerial economics, public policy, and quantitative methods. His research is in the fields of industrial organization, environmental economics, and the economics of regulation. Current work deals with natural gas rate design and EPA rule-making procedures.

Steven F. Maier, Ph.D., *Associate Professor of Business Administration*; B.S. (Cornell University), M.S., Ph.D. (Stanford University).

Professor Maier's teaching and research interests are in the areas of finance and operations research. He has written papers on such topics as cash management, capital budgeting, security markets, and portfolio theory. He is currently a consultant to more than a dozen banks in the area of cash management and has also been active in executive development programs. Prior to joining the Duke faculty, he spent two years as a member of the professional staff at the Stanford Research Institute.

Mary F. Mericle, Ph.D., *Assistant Professor of Business Administration*; B.S., Ph.D. (University of North Carolina at Chapel Hill).

Professor Mericle teaches in the areas of organizational behavior, leadership, group behavior, and organization theory. Her research interests include the effects of environmental, organization, and decision-maker attributes on the process of organizational adaptation. She has examined the boundary processes of coding and filtering by personnel subsystems and the effects of pressure to comply with affirmative action programs on personnel decisions.

Gary S. Monroe, Ph.D., *Assistant Professor of Business Administration*, B.S. (Northern Michigan University), Ph.D. (University of Massachusetts).

Professor Monroe teaches financial and managerial accounting. His primary research interest is in the behavior aspects of current-cost accounting information as a predictor of business failures.

Richard C. Morey, Ph.D., *Professor of Business Administration and Director of the Center for Applied Business Research*; B.S. (Syracuse University), M.A., Ph.D. (University of California at Berkeley).

Professor Morey comes to Duke with extensive business experience, having founded a management consulting firm and served as a consultant to many major businesses and governmental agencies. He teaches in the areas of operations management and control systems. As director of the Center for Applied Business Research, he coordinates research efforts of the faculty on actual business cases.

Bruce M. Owen, Ph.D., *Associate Professor of Business Administration*; B.A. (Williams College), Ph.D. (Stanford University).

Professor Owen's teaching and research interests are in antitrust and regulatory economics, industrial organization, microeconomics, and public policy analysis. He has served on the faculty of the Department of Economics at Stanford and has been a consultant to the White House Office of Telecommunications Policy and the Antitrust Division of the Justice Department.

John W. Payne, Ph.D., *Associate Professor of Business Administration*; B.A., M.A., Ph.D. (University of California at Irvine).

Prior to coming to Duke, Professor Payne was on the faculty of the Graduate School of Business at the University of Chicago. He is conducting research in individual decision behavior, applied decision-making, and human information processing. He teaches organizational behavior.

David W. Peterson, Ph.D., *Professor of Business Administration and Director of the Ph.D. Program; B.A. (University of Wisconsin), M.S., Ph.D. (Stanford University).*

Professor Peterson's teaching and research activities are in the fields of mathematical modeling, statistical analysis, and operations research. His recent publications have dealt with control theory, portfolio selection, long- and short-range planning and regulated utilities. He is a consultant to corporate and governmental litigation teams on matters pertaining to the structuring of statistically based legal positions.

Robert Taylor, Ph.D., *Assistant Professor of Business Administration; B.B.A., M.B.A. (Western Michigan University), Ph.D. (University of North Carolina).*

Professor Taylor's principal teaching responsibilities are in accounting and information systems. His research considers the effects of environmental, structural, and psychological variables on information processing within complex organizations. Dr. Taylor is also a frequent participant in executive development programs, generally presenting sessions on the behavioral implications of management accounting and information systems.

James Vander Weide, Ph.D., *Associate Professor of Business Administration; B.S. (Cornell University), Ph.D. (Northwestern University).*

Professor Vander Weide's primary research and teaching interests are in the areas of corporate finance and managerial economics. He has written papers on topics such as cash management, capital budgeting, portfolio analysis, and the economic effects of government regulation.

James W. Vaupel, M.P.P., *Assistant Professor of Business Administration and Policy Sciences; B.A., M.P.P. (Harvard University).*

Mr. Vaupel teaches in the area of multinational enterprise. His recent research and publications are concerned with analytical decision-making and its application to public policy formulation. He serves as a research associate of the Harvard Multinational Enterprise Project.



Class of 1978

M.B.A. Degree Recipients

Raymond Archer, (Ohio State University), Business Administration
John Armistead, (University of the South), Biology
David Ayers, (Clemson University), Accounting
Steven Campbell, (Dartmouth College), Economics
Stephanie Condakes, (Union College), Psychology
Curtis Conover, (Franklin & Marshall College), Business
Locke Conrad, (N. C. State University), Forestry
Richard Coss, (Western Maryland), Economics
Donald Dea, (Western Maryland), Economics
Brian Derksen, (University of Saskatchewan), Mathematics
Brian Dunn, (Dartmouth College), Government
Todd Elliott, (Allegheny College), Economics
Frederick Fagerstrom, (Princeton University), Electrical Engineering
David Gibbs, (Western State College), Mathematics/Physics
Elizabeth Hampton, (UNC-Greensboro), Economics/Business
William Haskett, (University of California), Mathematics/Economics
Alien Henderson, (Brown University), Electrical Engineering
Raymond Hooker, (University of Virginia), Mathematics/Religion
Barbara Hugo, (New York University), Psychology
David Isaacs, (Lake Forest University), Biology
David Jones, (Davidson College), Political Science
Howell Keezell, (UNC-Chapel Hill), Asian Studies
Charles Kendall, (U.S. Naval Academy), Applied Mathematics
Roy Kiefer, (Ohio Wesleyan University), Government
Frederick Koplin, (Northwestern University), Biology
Mark Kudla, (Colgate University), Economics
Richard Landers, (Claremont Men's College), Economics
Malcom Lathan, (UNC-Chapel Hill), Business Administration
Charles Martin, (Gettysburg College), Business Administration
Joseph McLaughlin, (Middlebury College), Economics
Kenneth Morton, (Thiel College), Business Administration
Barry Murrill, (Salem College), Mathematics/Chemistry
Laurence Nettles, (University of Santa Clara), Economics
Richard Nicholas, (Boston College), Political Science/Philosophy



James O'Neill, (Vanderbilt University), Business Administration
 Ernest Ott, (University of Maryland), Economics
 Daniel Pendarvis, (Georgia Inst. of Technology), Industrial Engineering
 Elizabeth Pinson, (University of Florida), Finance
 Gilbert Pringle, (University of Virginia), Electrical Engineering
 Janet Rathke, (Middlebury College), Mathematics/Spanish
 Roy Rieve, (U.S. Naval Academy), Systems Engineering
 Katherine Rogers, (Colby College), Government/Sociology
 Gary Rooth, (N.C. State University), Economics/Business Administration
 William Rupp, (Georgia Inst. of Technology), Electrical Engineering
 Vincent Santo, (Bucknell University), Business Administration
 Robert Schramm, (Cornell University), Industrial/Labor Relations
 Tate Scott, (Duke University), Psychology
 Donald Shiffrin, (UNC-Chapel Hill), History
 Jay Smith, (University of Maine), Business Administration
 Daniel Smith, (Davidson College), Economics
 Anne Spitz, (Wellesley College), Political Science
 David Steele, (Clemson University), Economics
 William Sutherland, (Duke University), Civil Engineering
 Gregory Torski, (Lehigh University), Industrial Engineering
 John Wicker, (UNC-Asheville), Economics
 Wade Winstead, (UNC-Chapel Hill), Business Administration
 William Wise, (U.S. Naval Academy), Management
 Linda Wright, (George Mason University), Business



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